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Climate and Marine Department
Japan Meteorological Agency

気象庁 気候・海洋気象部

平成１０年１２月

気象庁海洋月報は、気象庁 気候・海洋気象部 海洋課で作成しています。
本月報に関する問い合わせは、
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表紙は、1998年12月の太平洋の月平均海面水温偏差図です。
陰影部は、平年より高温の海域を示しています。

The figure on the front cover shows the monthly mean SST anomalies for December 1998 in the Pacific Ocean.
Areas of positive anomalies are shaded.

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海況の特徴（１９９８年１２月）

日本近海の海況

海面水温は，オホーツク海南部から北海道の東にかけてと東海沖で平年より0.5℃以上低かった。三陸・常磐沖と紀伊半島沖から南西諸島にかけて平年より１℃以上高かった（第4図）。

黒潮は，九州の東で離岸した後，上旬は四国から紀伊半島にかけて接岸していたが，中旬には足摺岬でも離岸し，下旬には紀伊半島にのみ接岸する流路となった。東海沖では，上・中旬は東南東に流れた後に八丈島の南に，下旬は東に流れ八丈島付近に，それぞれ達していた。その後は，141°Eに沿って北上した後，房総半島沖を東北東に流れていた（第9図）。

親潮系の冷水の沿岸寄りの分枝は41.5°N，143.5°Eまで，沖合の分枝は40.5°N，146.0°Eまで，それぞれ達していた（第5図）。

太平洋の海況

太平洋赤道域の海面水温は，160°Eから95°Wにかけて平年より低く，170°Wから120°Wにかけて-2℃以下の負偏差域が見られた。150°E以西では，+0.5℃以上の正偏差が持続していた。

北太平洋では，日本の南から30°Nに沿って160°Wまで，+1℃以上の正偏差域となっていた。

南太平洋では，先月に引き続き40°S以北のほぼ全域で正偏差となり，20°Sに沿った日付変更線から160°Wにかけての海域では，+2℃以上の正偏差となっていた（第16図）。

Highlights December 1998

Seas adjacent to Japan

SSTs were more than 0.5°C below normal in the southern part of the Sea of Okhotsk, east of Hokkaido, and off Tokai. Positive SST anomalies exceeding +1°C prevailed off Sanriku, off Joban, and from the seas off the Kii Peninsula to those around the Nansei Islands (Fig. 4).

The Kuroshio flowed off Kyushu and along the coasts from Shikoku to the Kii Peninsula in the first 10-day of the month, off the coasts from Kyushu to Ashizuri-Misaki in the second 10-day, and off south coasts of Japan except the Kii Peninsula in the last 10-day. East of the Kii Peninsula, it flowed ESE-ward and passed south of Hachijo Island in the first and second 10-days of the month, and it flowed eastward near Hachijo Island in the last 10-day. Then it flowed northward along 141°E and ENE-ward off the Boso Peninsula (Fig. 9).

Coastal and off-coastal branches of the Oyashio cold water extended southward to 41.5°N, 143.5°E and 40.5°N, 146.0°E, respectively (Fig. 5).

Pacific Ocean

In the equatorial Pacific, negative SST anomalies prevailed from 160°E to 95°W, and those exceeding -2°C were observed from 170°W to 120°W. Positive SST anomalies exceeding +0.5°C remained from 150°E westward.

In the North Pacific, positive SST anomalies exceeding +1°C prevailed from the seas south of Japan eastward to 160°W along 30°N.

In the South Pacific, positive SST anomalies prevailed north of 40°S, and SSTs were more than 2°C above normal from the date line to 160°W along 20°S (Fig. 16).

北西太平洋における二酸化炭素の観測
Observation of carbon dioxide in the western North Pacific

気象庁の海洋気象観測船「凌風丸」は，1998年9月17日から11月10日にかけて，北西太平洋で表面海水中および洋上大気中の二酸化炭素濃度（分圧，pCO_2）の観測を実施した。

9月の千島列島の南方海域および165°Eの48°N以北の海域は，表面海水中のpCO_2は大気のそれと比べて低く，二酸化炭素の吸収域であった。一方，10月の赤道付近では，表面海水中のpCO_2は大気のそれと比べて高く，二酸化炭素の放出域であった。この時期，太平洋赤道域の中・東部では海面水温が平年より低く，ラニーニャ現象時に見られる特徴を呈していた。気象庁の観測では，赤道に沿った表面海水中のpCO_2が大気のそれより30μatm以上高かったのは，ラニーニャ現象に近い状態であった1996年11月以来である（気象庁海洋月報No.48参照）。

The Japan Meteorological Agency (JMA) observed carbon dioxide concentrations (partial pressure, pCO_2) in the surface water and the overlying atmosphere in the western North Pacific on board R/V *Ryofu Maru* from September 17 to November 10, 1998.

In the regions south of the Kuril Islands and north of 48°N along 165°E in September 1998, the pCO_2 in the surface water were lower than those in the atmosphere, implying that atmospheric CO_2 was absorbed into the ocean. In the western equatorial Pacific in October 1998, the pCO_2 in the surface water were higher than in the atmosphere, implying that oceanic CO_2 was emitted into the atmosphere. Central and eastern equatorial Pacific was under the cold episode conditions during the observation. This is the first time that the pCO_2 in the surface sea water exceeded 30μatm as compared to those in the atmosphere along the equator since November 1996 under slightly cooler-than-normal ENSO conditions (see Monthly Ocean Report No.48).

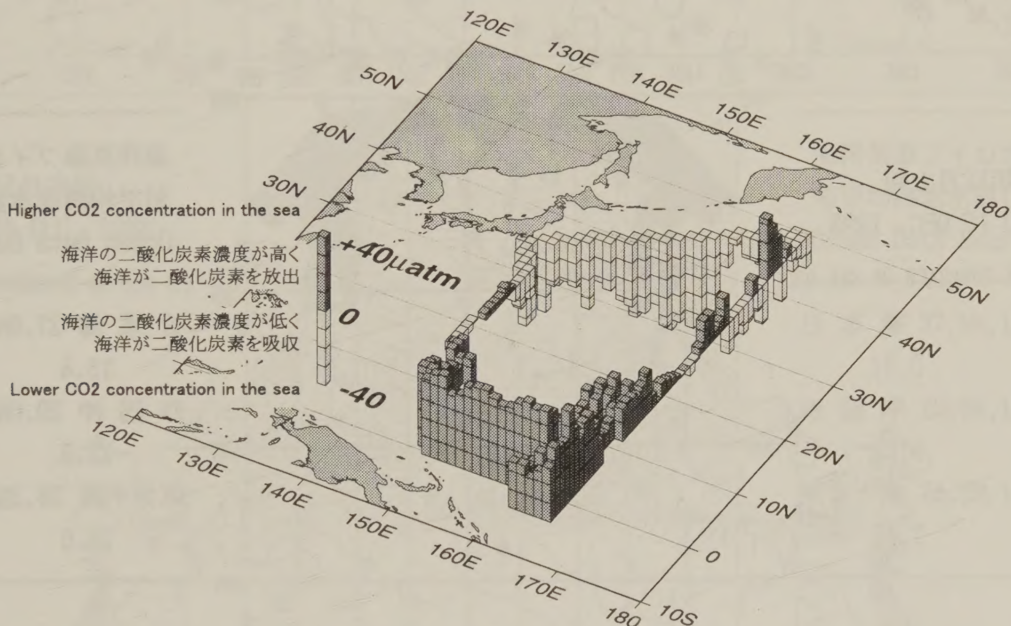
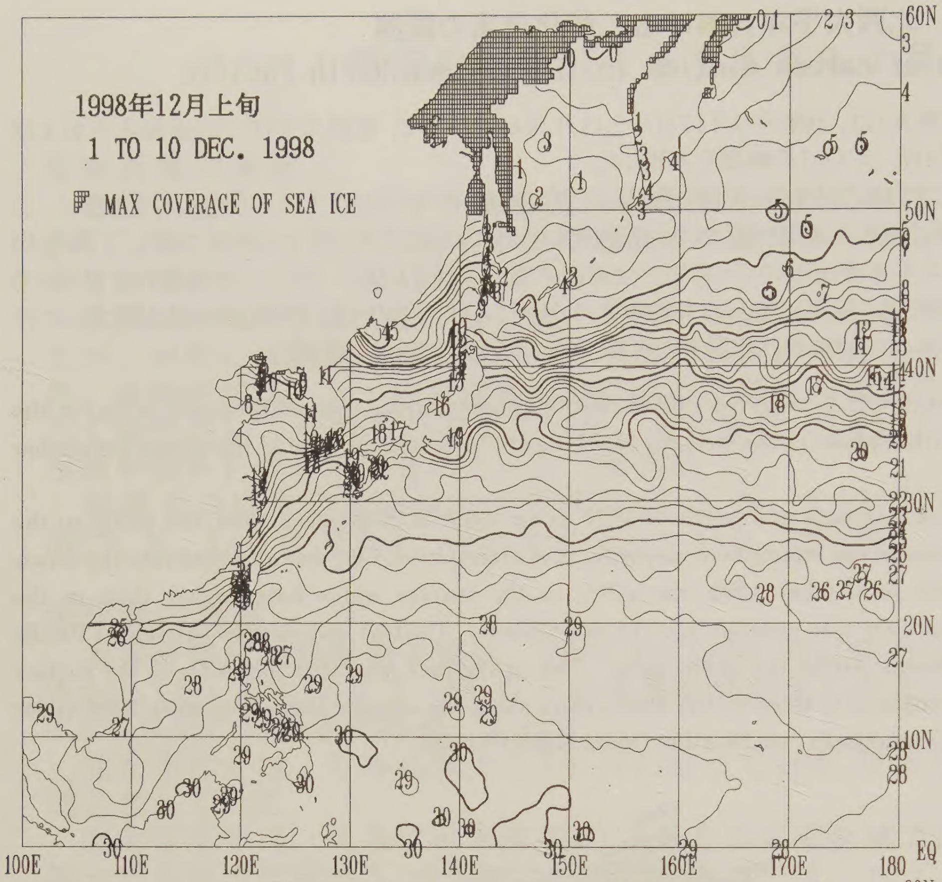


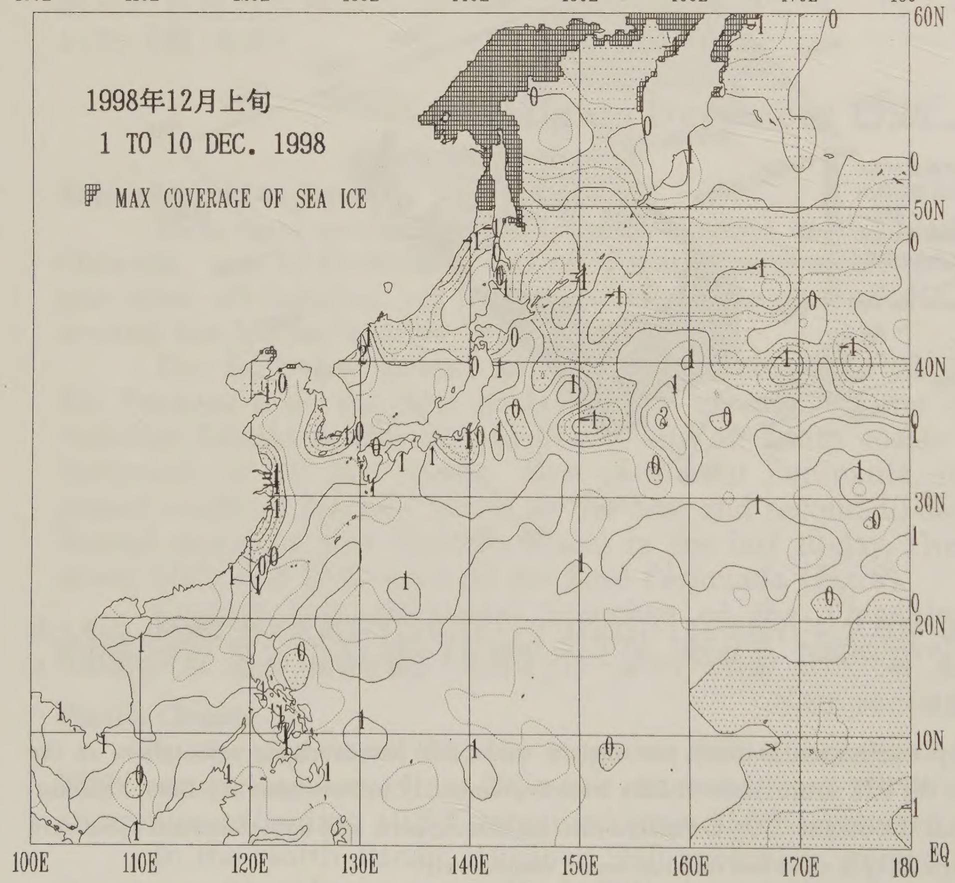
図 A　気象庁の海洋気象観測船「凌風丸」が1998年9月17日から11月10日にかけて北西太平洋で観測した洋上大気中と表面海水中のCO_2の濃度差。棒グラフは，海洋から大気へCO_2を放出する場合を濃い陰影，および海洋が大気のCO_2を吸収する場合を薄い陰影に示してある。

Fig. A　Difference in the CO2 concentration between the surface water and the overlying atmosphere in the western North Pacific observed by the R/V *Ryofu Maru* of JMA from September 17 to November 10, 1998. Darker-shaded upward pillars indicate that the oceanic CO_2 is emitted into the atmosphere, and lighter-shaded downward pillars indicate that the atmospheric CO_2 is absorbed into the ocean, respectively.

Ten-day mean SST & Anomalies



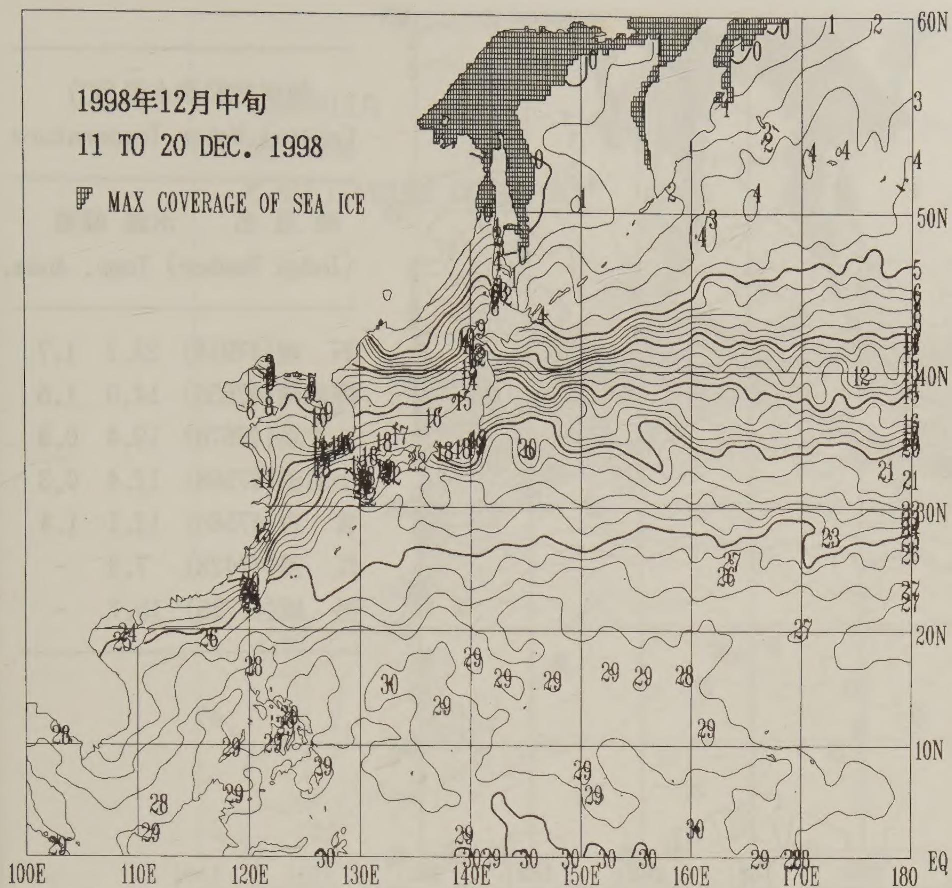
旬平均沿岸水温(℃) Coastal Water Temperature		
地点名 (Index Number)	水温 Temp.	偏差 Anom.
石　垣(47918)	24.7	2.3
御前崎(47655)	14.7	0.4
八丈島(47678)	-	-
小名浜(47598)	13.3	-0.5
宮　古(47585)	13.4	0.6
江　差(47428)	9.3	-
浜　田(47755)	17.1	-



海洋気象ブイロボット 旬平均海面水温(℃) Ocean Data Buoy SST	
日本海 37.9N,134.5E	15.8
四国沖 29.0N,135.0E	23.8
東シナ海 28.2N,126.3E	24.6

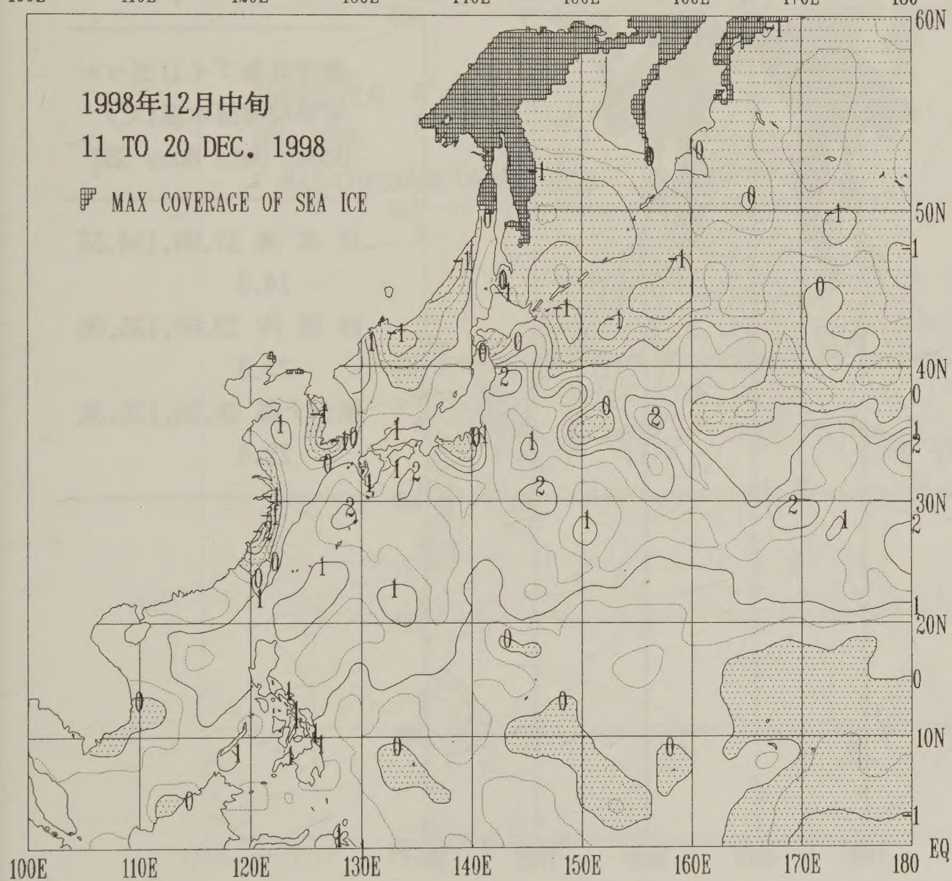
第1図 北西太平洋旬平均海面水温図(上)及び偏差図(下)(1998年12月上旬)

Fig.1 Ten-day mean SST (top) and anomalies (bottom) in the western North Pacific for the 1st ten-day period in DEC 1998. Anomalies are computed from the JMA climatology (1961-90). Contour interval is 1°C and additional anomaly contours of 0.5°C are shown by broken lines. Negative anomalies are spotted.



旬平均沿岸水温(℃)
Coastal Water Temperature

地点名 (Index Number)	水温 Temp.	偏差 Anom.
石　垣(47918)	23.3	1.5
御前崎(47655)	13.4	-0.1
八丈島(47678)	-	-
小名浜(47598)	12.6	-0.5
宮　古(47585)	12.9	1.2
江　差(47428)	8.7	-
浜　田(47755)	16.8	-

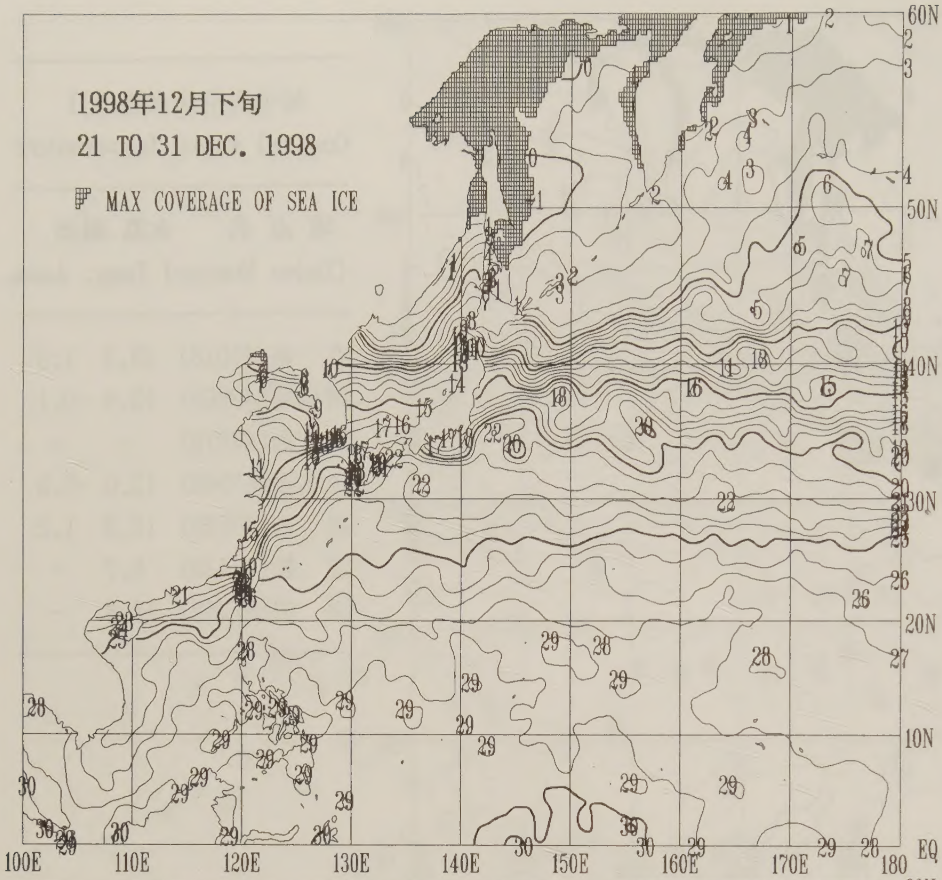


海洋気象ブイロボット
旬平均海面水温(℃)
Ocean Data Buoy SST

日本海	37.9N,134.5E	15.0
四国沖	29.0N,135.0E	23.4
東シナ海	28.2N,126.3E	24.2

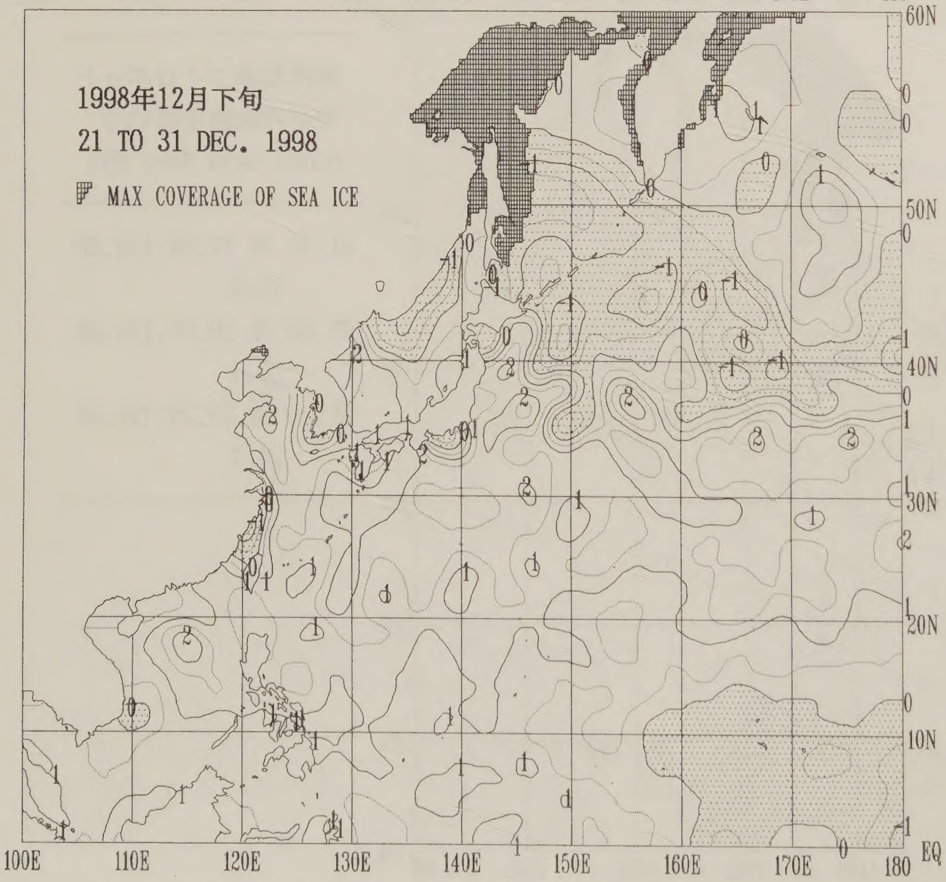
第2図 北西太平洋旬平均海面水温図(上)及び偏差図(下)(1998年12月中旬)

Fig.2 Ten-day mean SST (top) and anomalies (bottom) in the western North Pacific for the 2nd ten-day period in DEC 1998. Anomalies are computed from the JMA climatology (1961-90). Contour interval is 1°C and additional anomaly contours of 0.5°C are shown by broken lines. Negative anomalies are spotted.



旬平均沿岸水温(℃)
Coastal Water Temperature

地点名 (Index Number)	水温 Temp.	偏差 Anom.
石　垣(47918)	23.2	1.7
御前崎(47655)	14.0	1.6
八丈島(47678)	19.4	0.8
小名浜(47598)	12.4	0.3
宮　古(47585)	12.1	1.4
江　差(47428)	7.3	-
浜　田(47755)	15.7	-

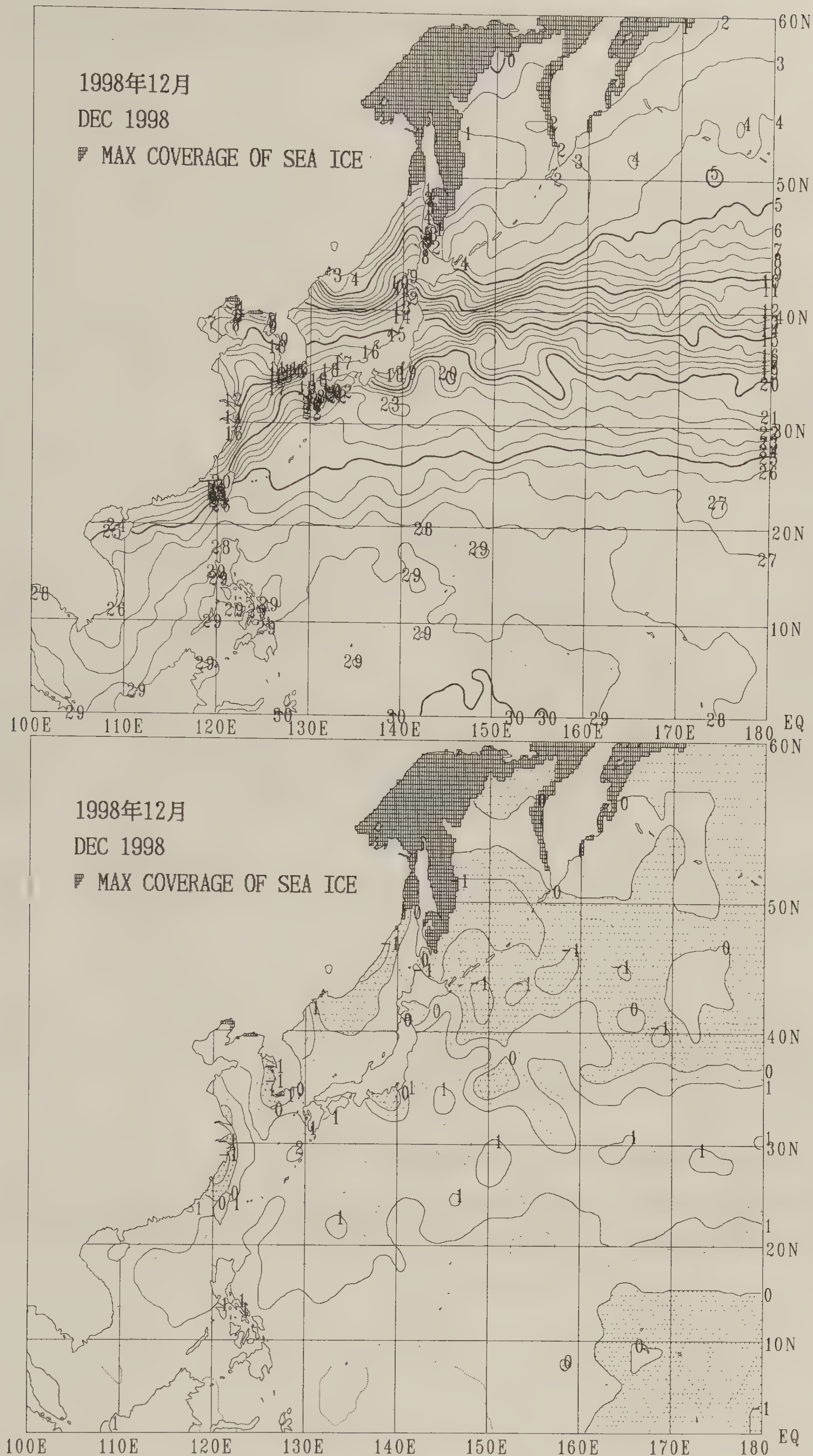


海洋気象ブイロボット
旬平均海面水温(℃)
Ocean Data Buoy SST

日本海	37.9N,134.5E	14.3
四国沖	29.0N,135.0E	23.3
東シナ海	28.2N,126.3E	22.4

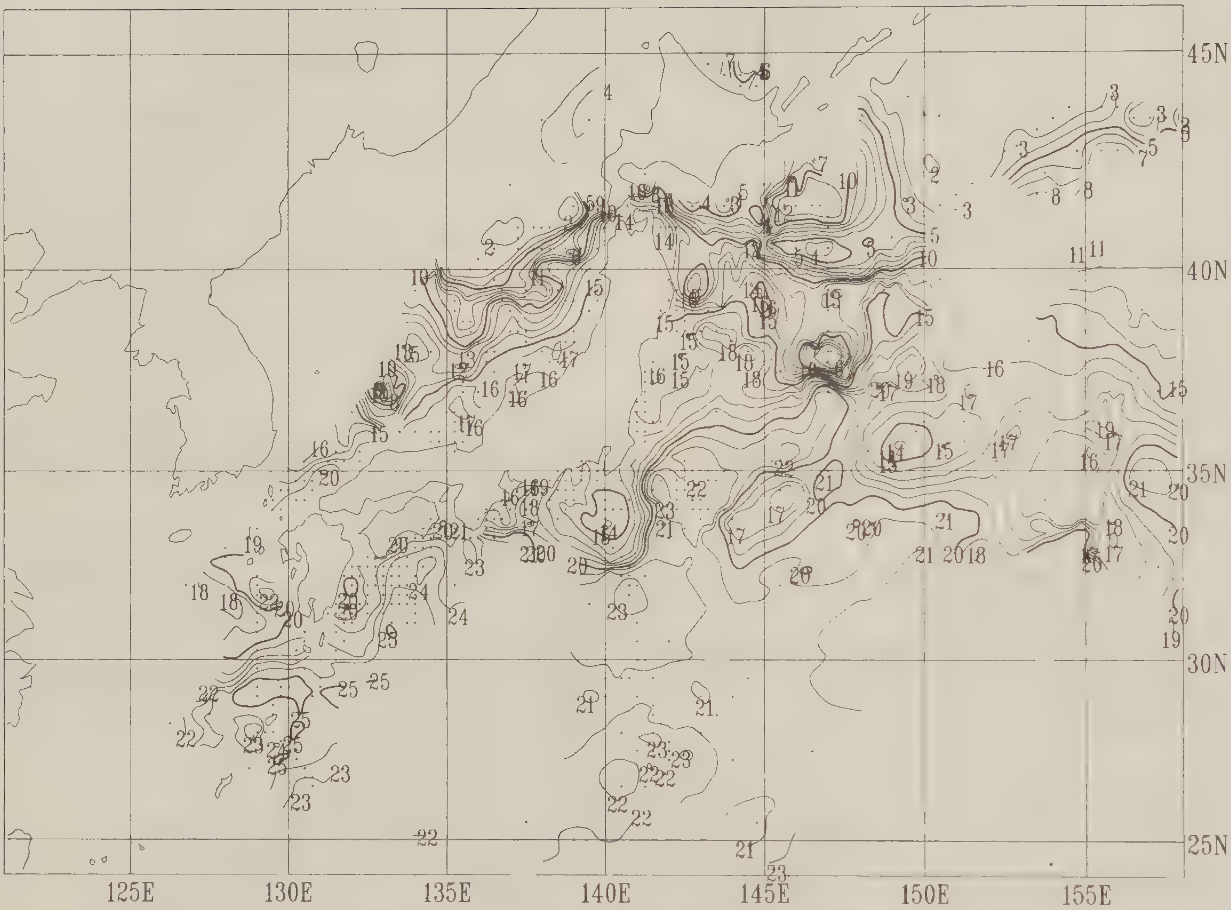
第3図 北西太平洋旬平均海面水温図(上)及び偏差図(下)(1998年12月下旬)

Fig.3 Ten-day mean SST (top) and anomalies (bottom) in the western North Pacific for the 3rd ten-day period in DEC 1998. Anomalies are computed from the JMA climatology (1961-90). Contour interval is 1°C and additional anomaly contours of 0.5°C are shown by broken lines. Negative anomalies are spotted.



第4図 北西太平洋月平均海面水温図(上)及び偏差図(下)(1998年12月)

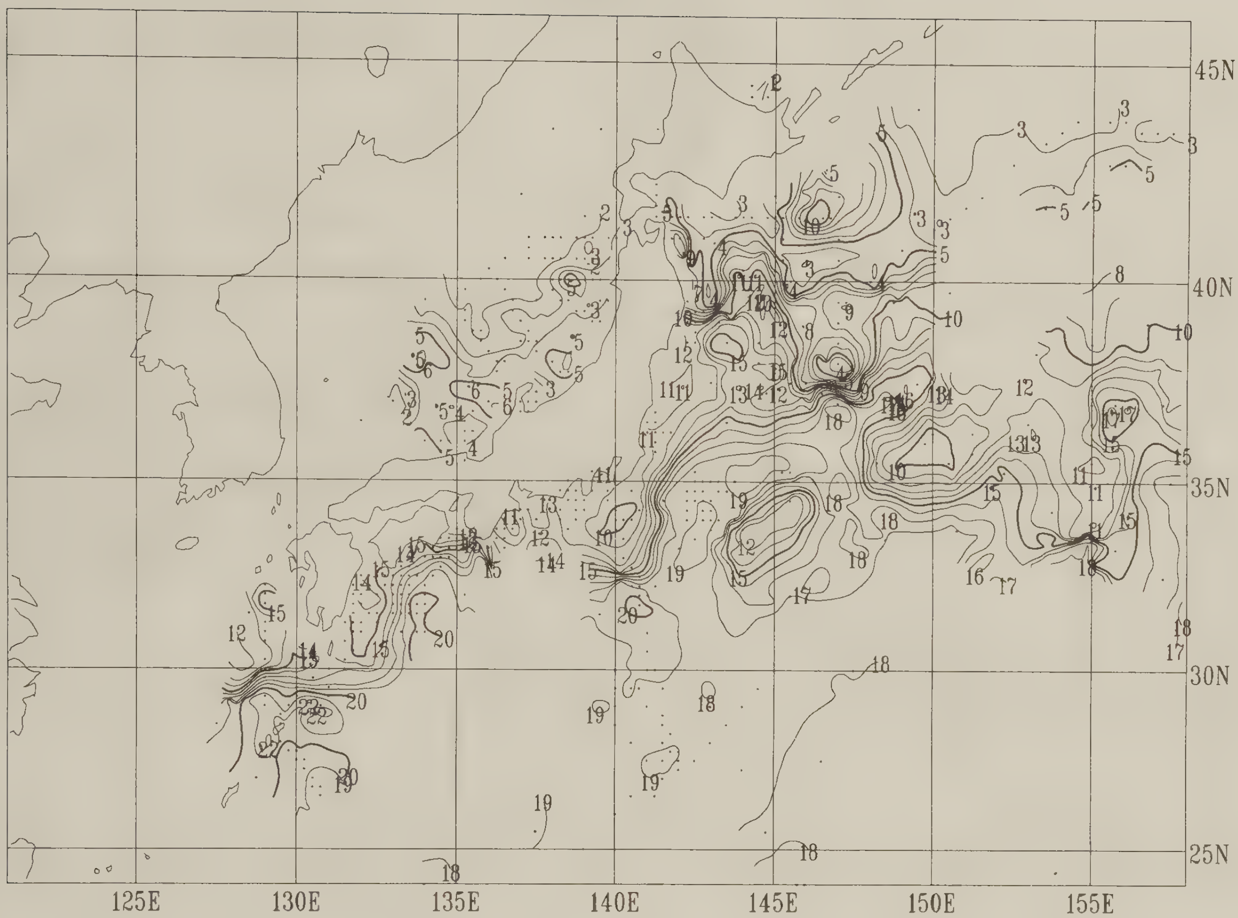
Fig.4 Monthly mean SST (top) and anomalies (bottom) in the western North Pacific for DEC 1998. Anomalies are computed from the JMA climatology (1961-1990). Contour interval is 1°C and additional anomaly contours of 0.5°C are shown by broken lines. Negative anomalies are spotted.



第5図　日本近海表層水温図(深さ100m) (1998年12月)

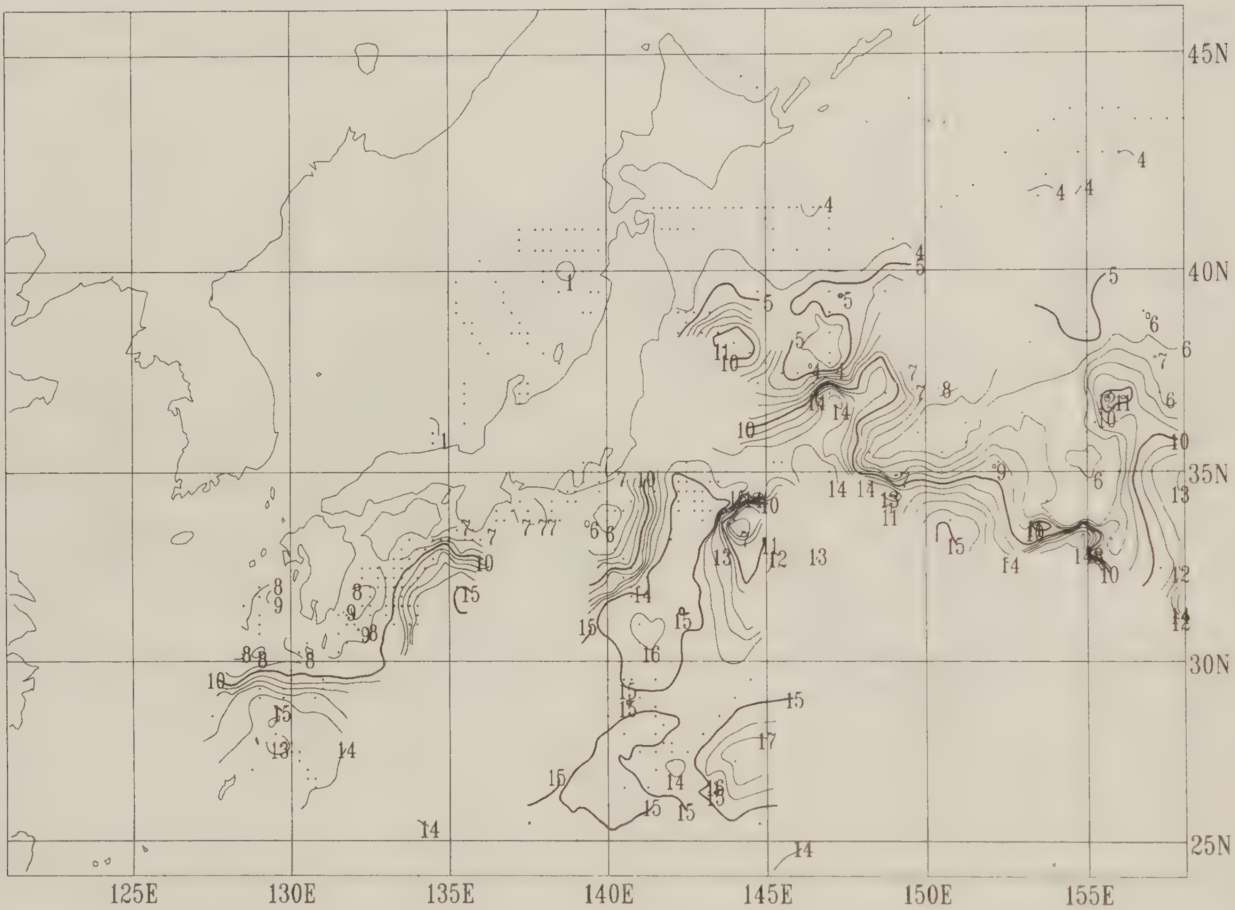
Fig.5 Subsurface (100m) temperatures in the seas adjacent to Japan for DEC 1998. Contour interval is 1°C. Observation points are denoted by dots.

200m Temperatures in the Seas Adjacent to Japan



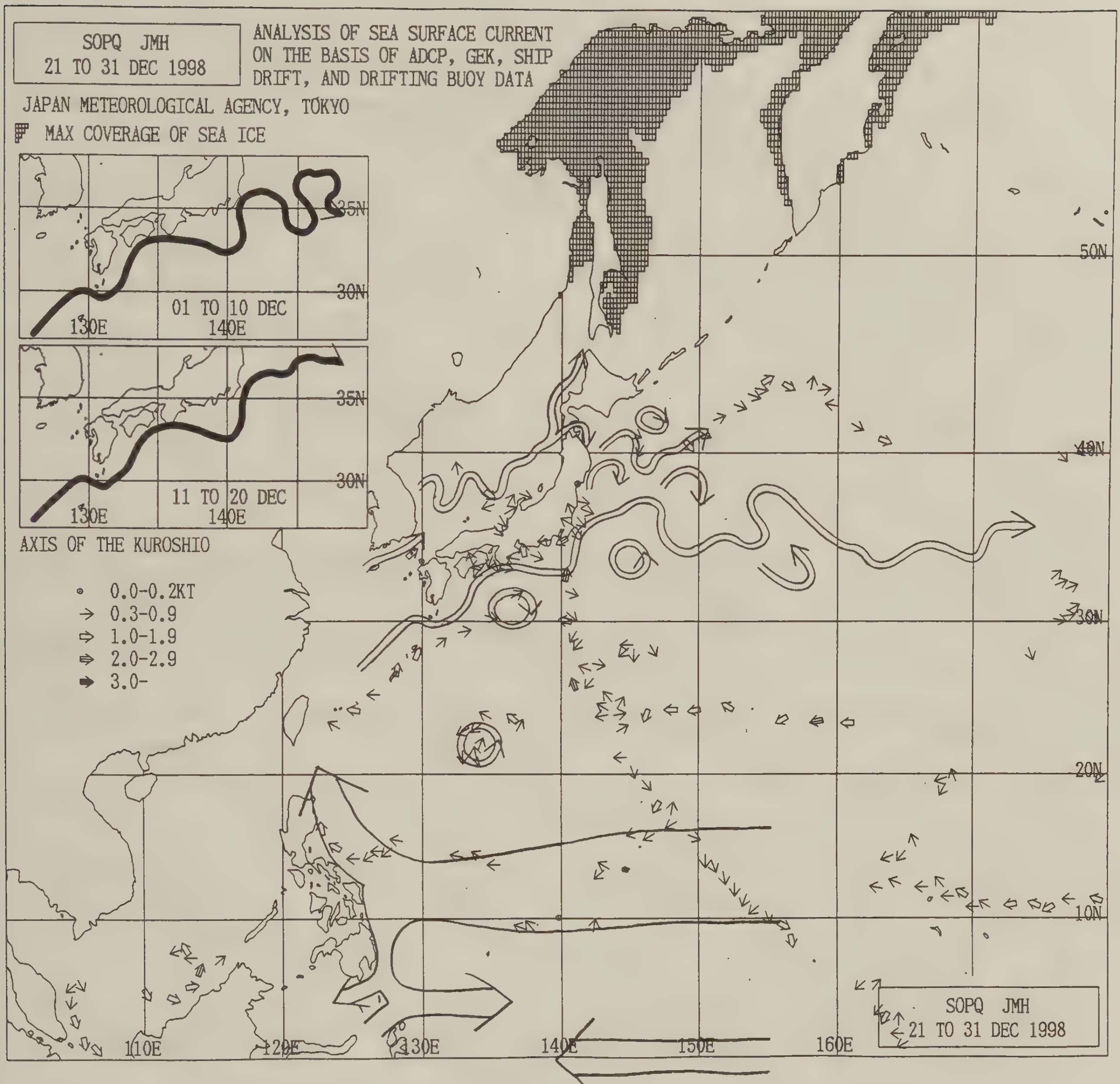
第6図　日本近海表層水温図(深さ200m) (1998年12月)

Fig.6　Subsurface (200m) temperatures in the seas adjacent to Japan for DEC 1998.　Contour interval is 1°C.　Observation points are denoted by dots.



第7図　日本近海表層水温図(深さ400m)(1998年12月)

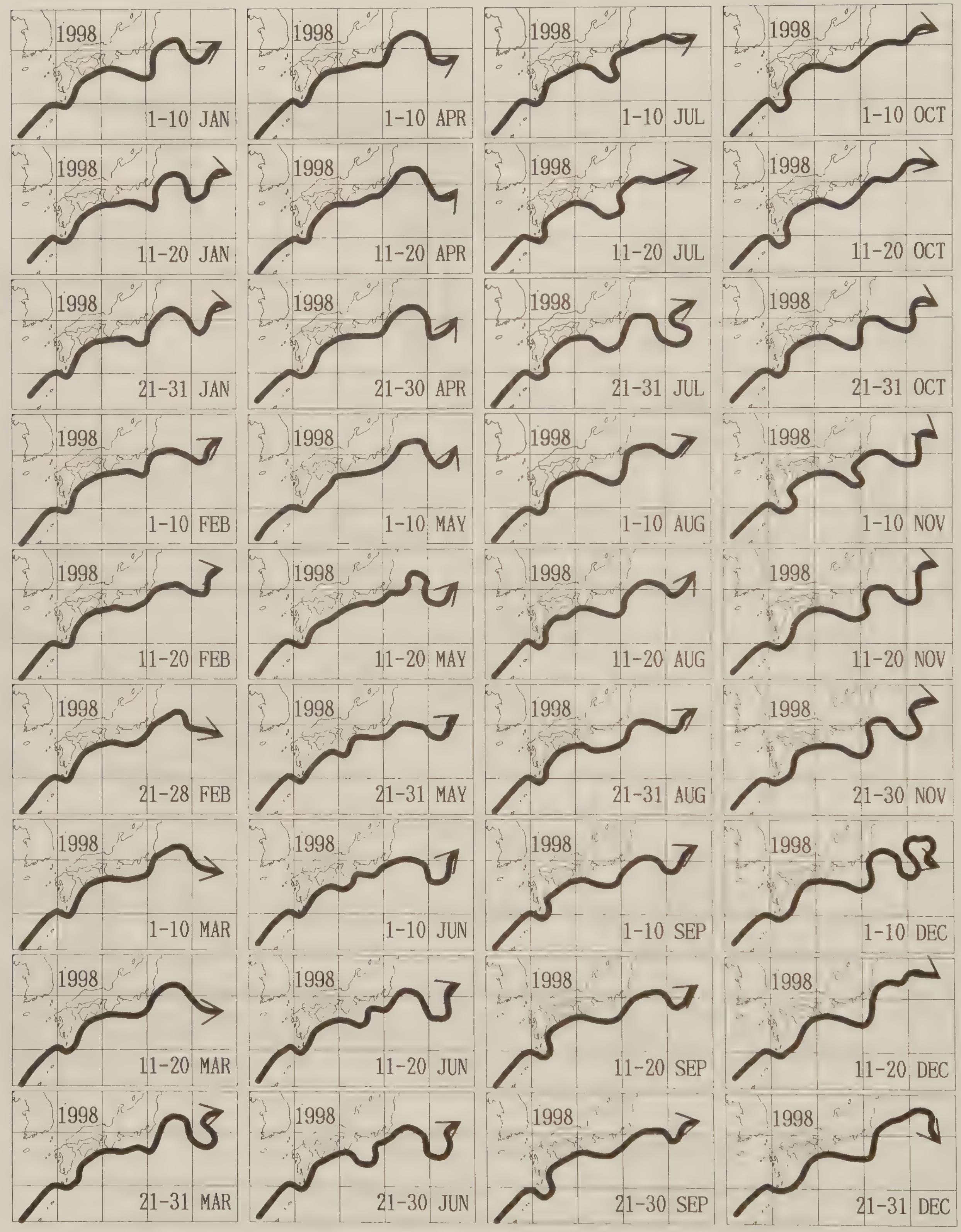
Fig.7　Subsurface (400m) temperatures in the seas adjacent to Japan for DEC 1998.　Contour interval is 1°C.　Observation points are denoted by dots.



第8図　北西太平洋海流図（1998年12月下旬）

Fig.8 Analysis of the sea surface current in the western North Pacific for the 3rd ten-day period in DEC 1998. Small arrows indicate in situ observations. Major currents such as the Kuroshio and the North Equatorial Current are denoted by larger open arrows.

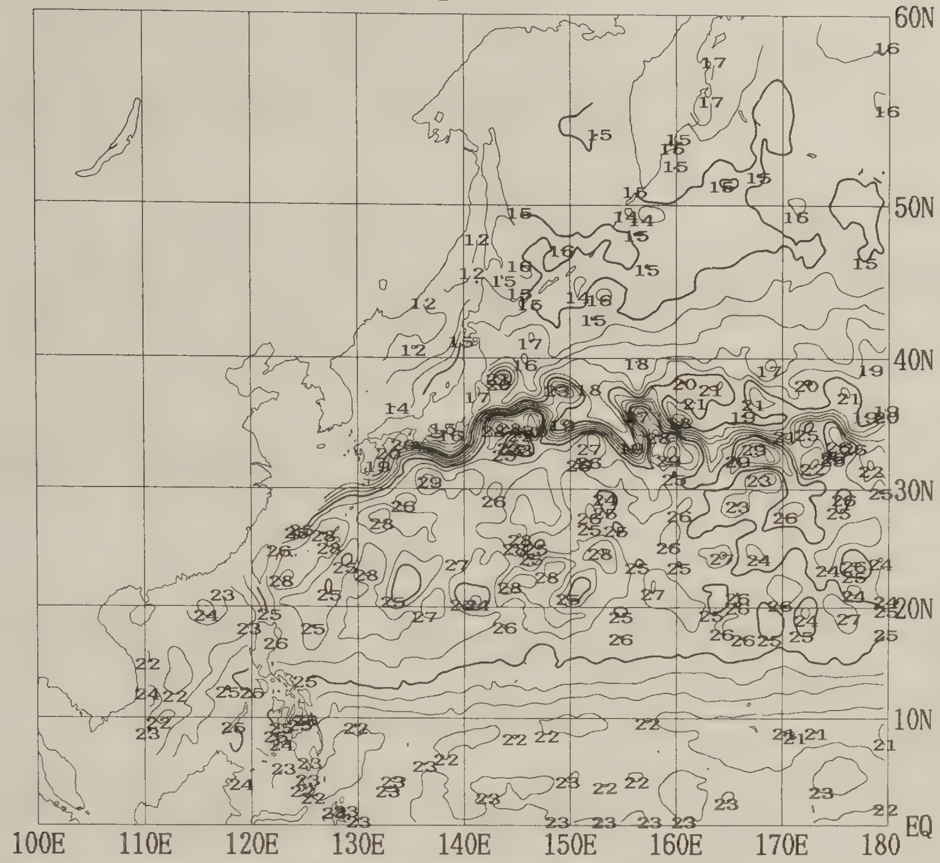
Location of the Kuroshio axis



第9図 旬別黒潮流軸図

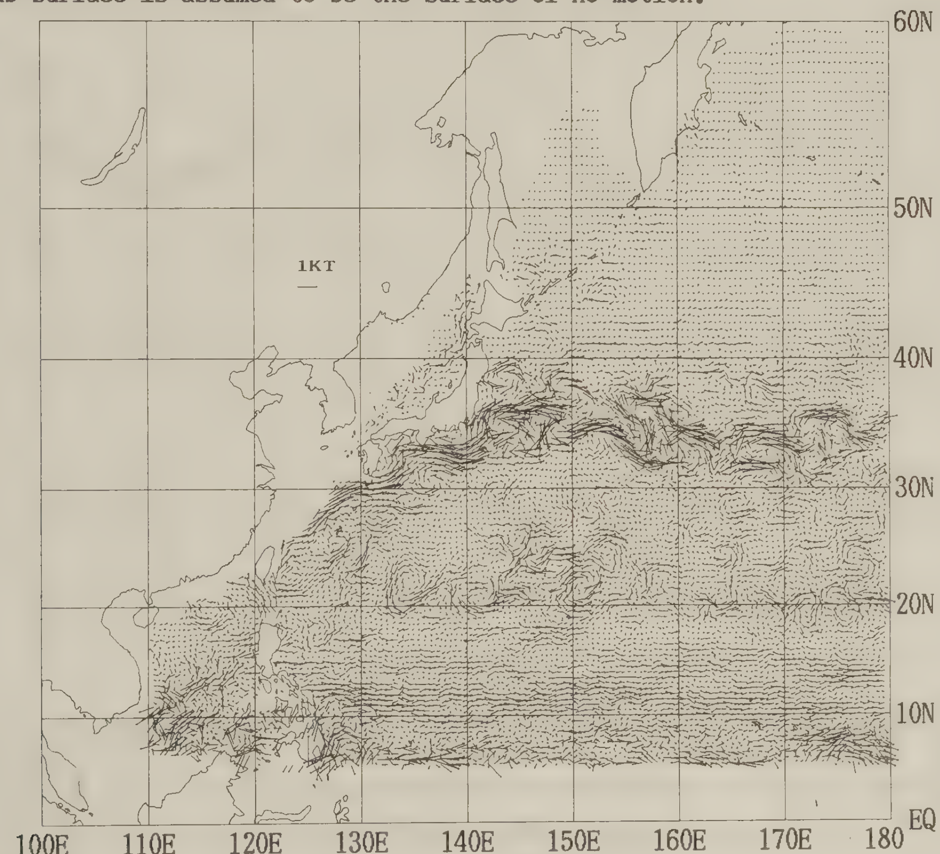
Fig.9 Location of the Kuroshio axis

Sea surface dynamic heights and current distribution



第10図 北西太平洋力学的海面高度分布図(1998年12月16日)

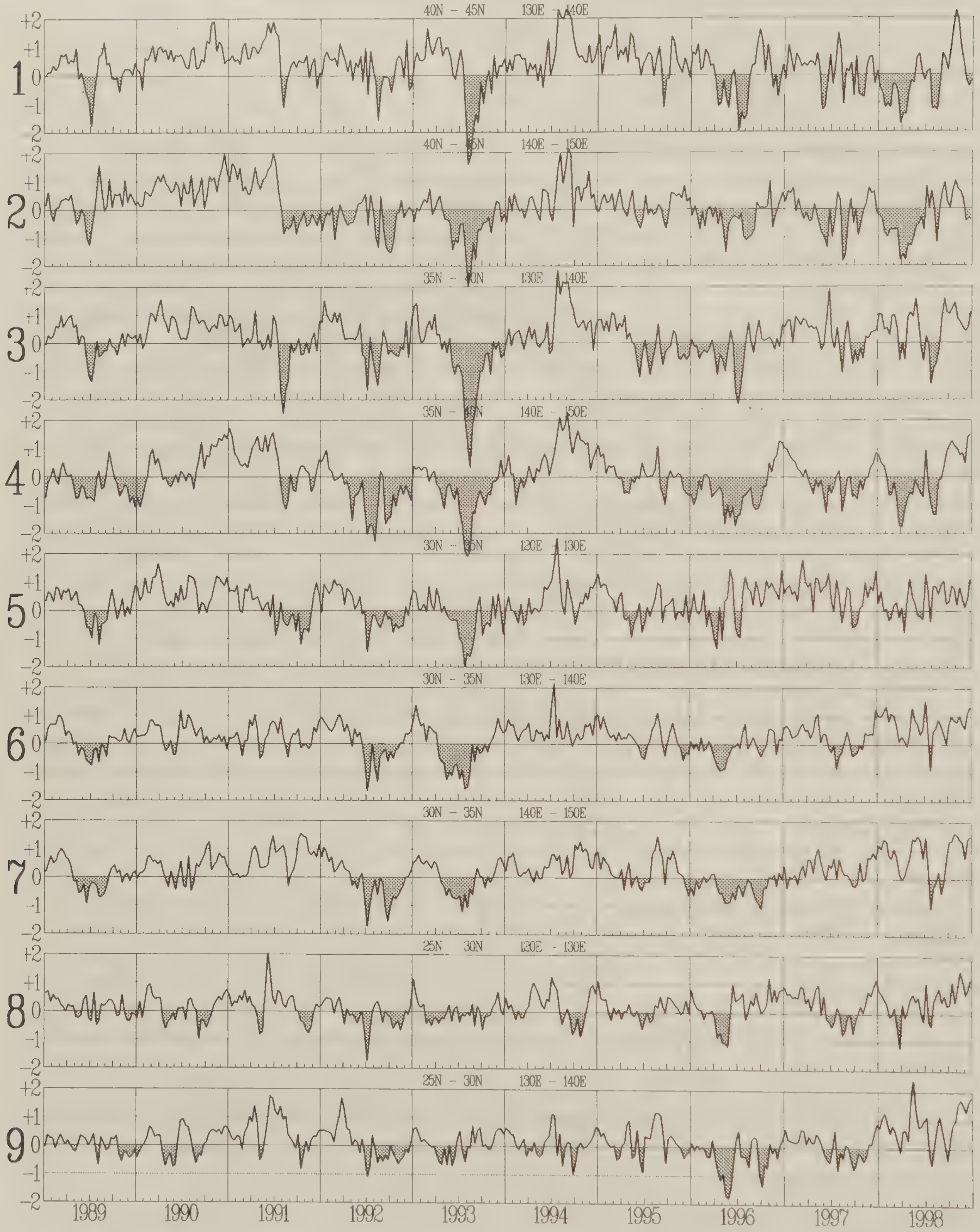
Fig.10 Sea surface dynamic heights (10cm) in the western North Pacific derived from the altimeter data of TOPEX/POSEIDON (DEC 16, 1998).
1500db surface is assumed to be the surface of no motion.



第11図 北西太平洋海流ベクトル図(1998年12月16日)

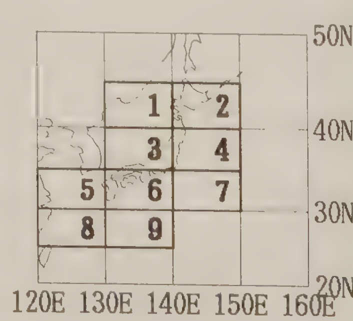
Fig.11 Sea surface current vectors in the western North Pacific (DEC 16, 1998). Vectors are derived from the sea surface dynamic heights from TOPEX/POSEIDON and subsurface temperature distribution assuming the geostrophic relation.

Time Series of Area Mean SST in the Western North Pacific

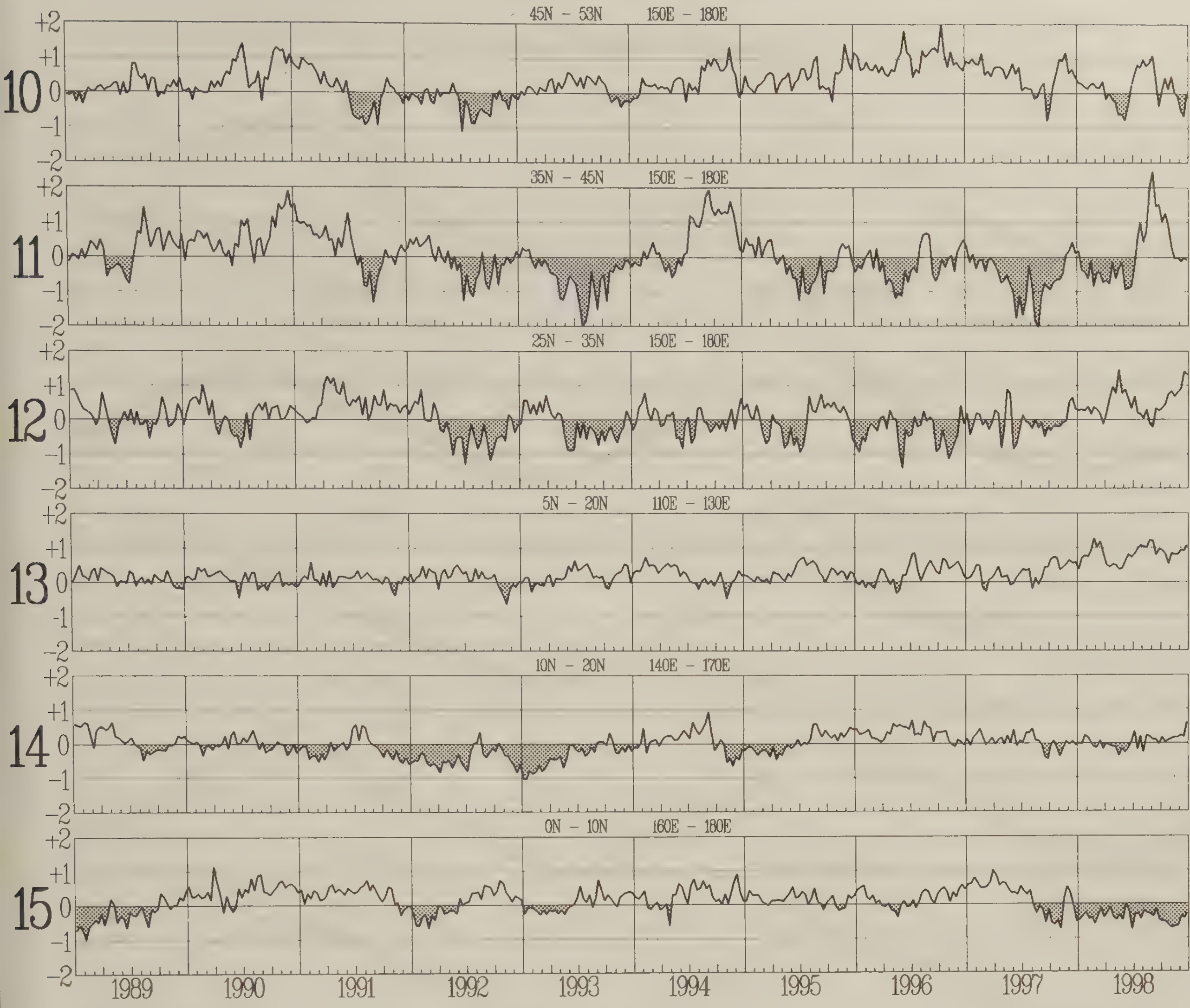


第12図　海域別旬平均海面水温平年偏差時系列図

Fig.12 Time series of the ten-day mean sea surface temperature anomalies (°C) in the western North Pacific for the areas shown in the right panel. Negative anomalies are shaded. Anomalies are computed from the JMA climatology (1961-90).

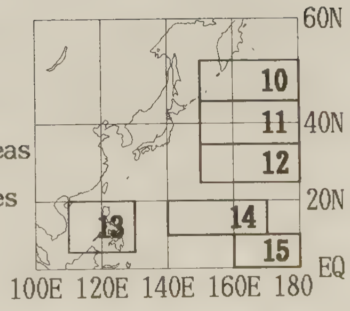


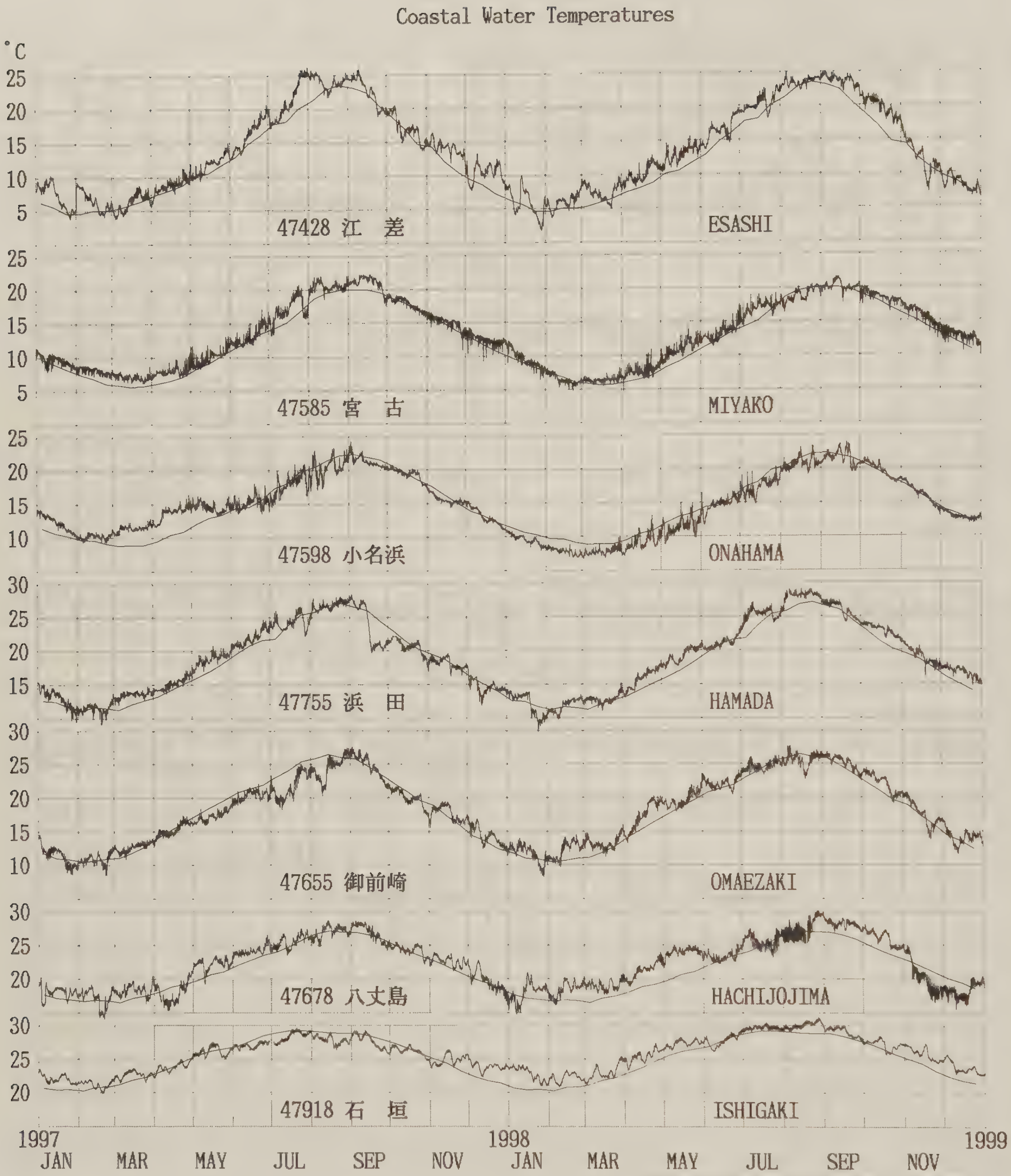
Time Series of Area Mean SST in the Western North Pacific



第12図　海域別旬平均海面水温平年偏差時系列図（つづき）

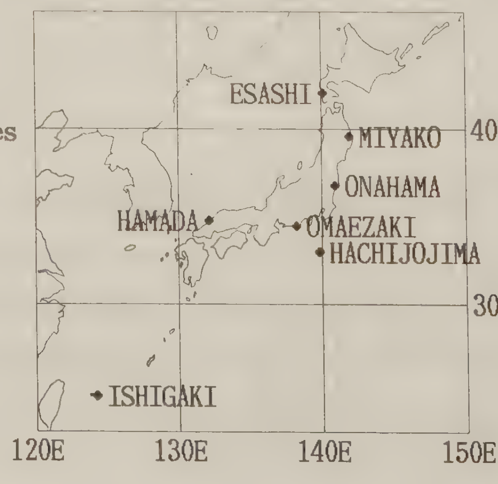
Fig.12 (continue) Time series of the ten-day mean sea surface temperature anomalies (°C) in the western North Pacific for the areas shown in the right panel. Negative anomalies are shaded. Anomalies are computed from the JMA climatology (1961-90).

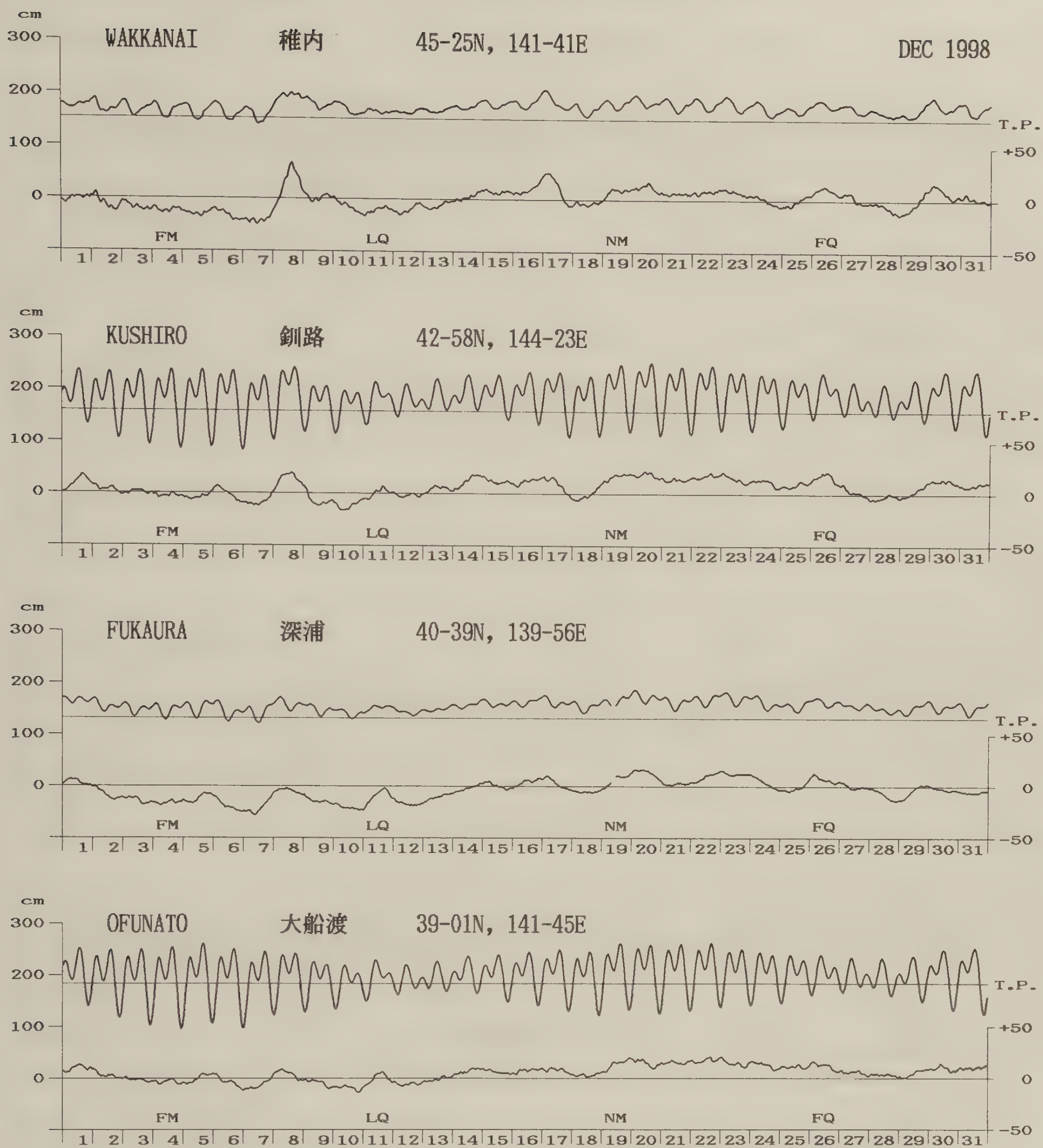




第13図 沿岸水温時系列図

Fig.13 Time series of hourly coastal water temperatures (°C) measured at 7 coastal stations of the JMA shown in the right panel.
Thin lines show ten-day mean climatology.

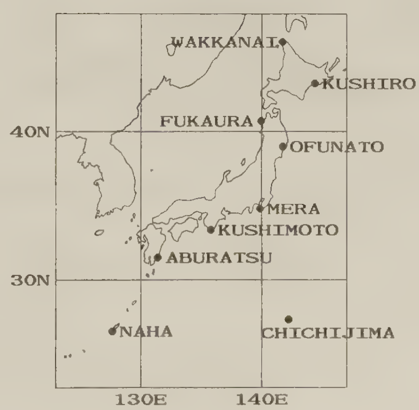


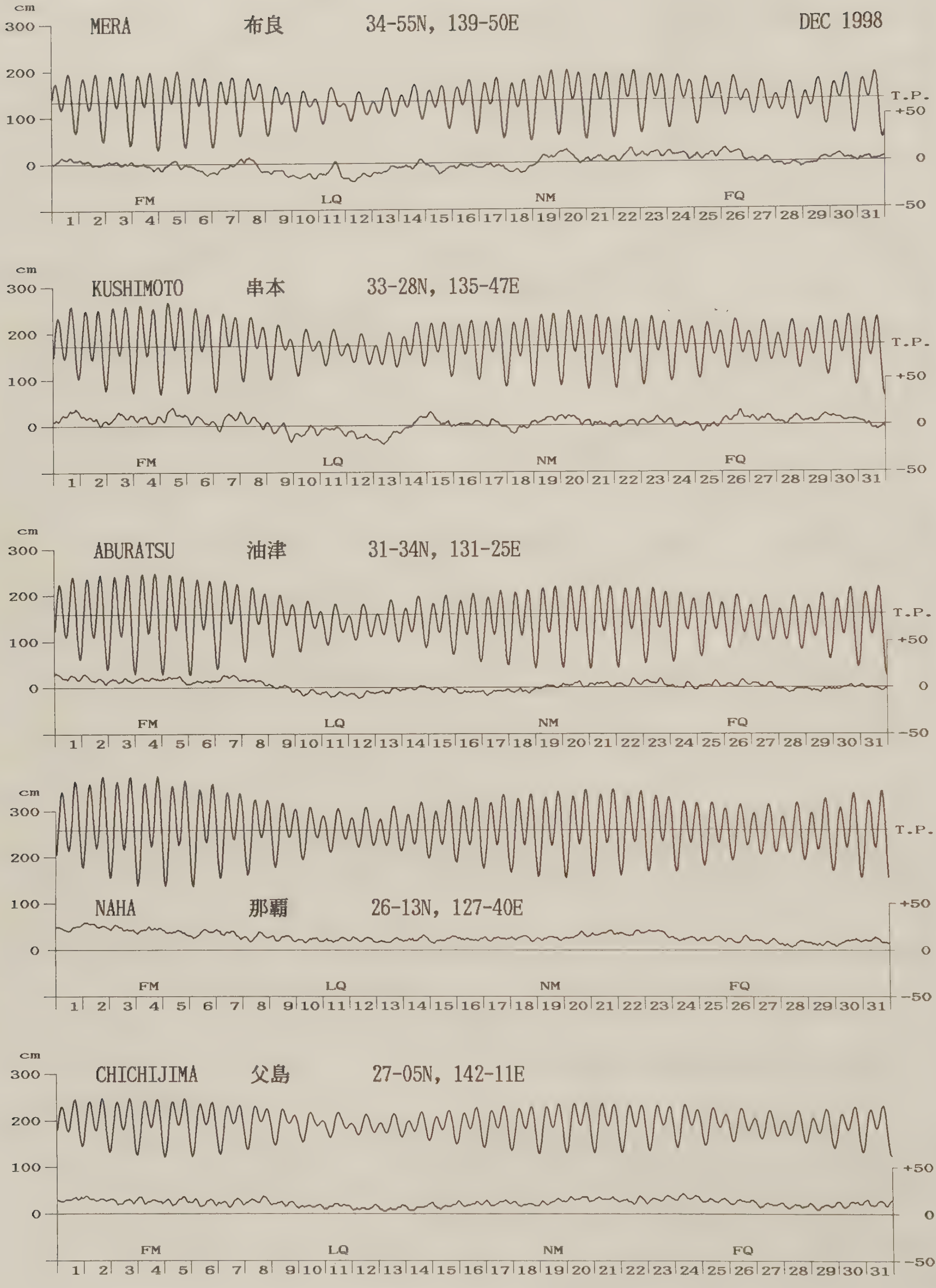


第14図 沿岸潮位時系列図（1998年12月）

Fig.14 Time series of hourly sea level observation (upper line) and its anomalies (lower line) at 9 stations of the JMA in the right panel.
Short term variations are removed from raw data.

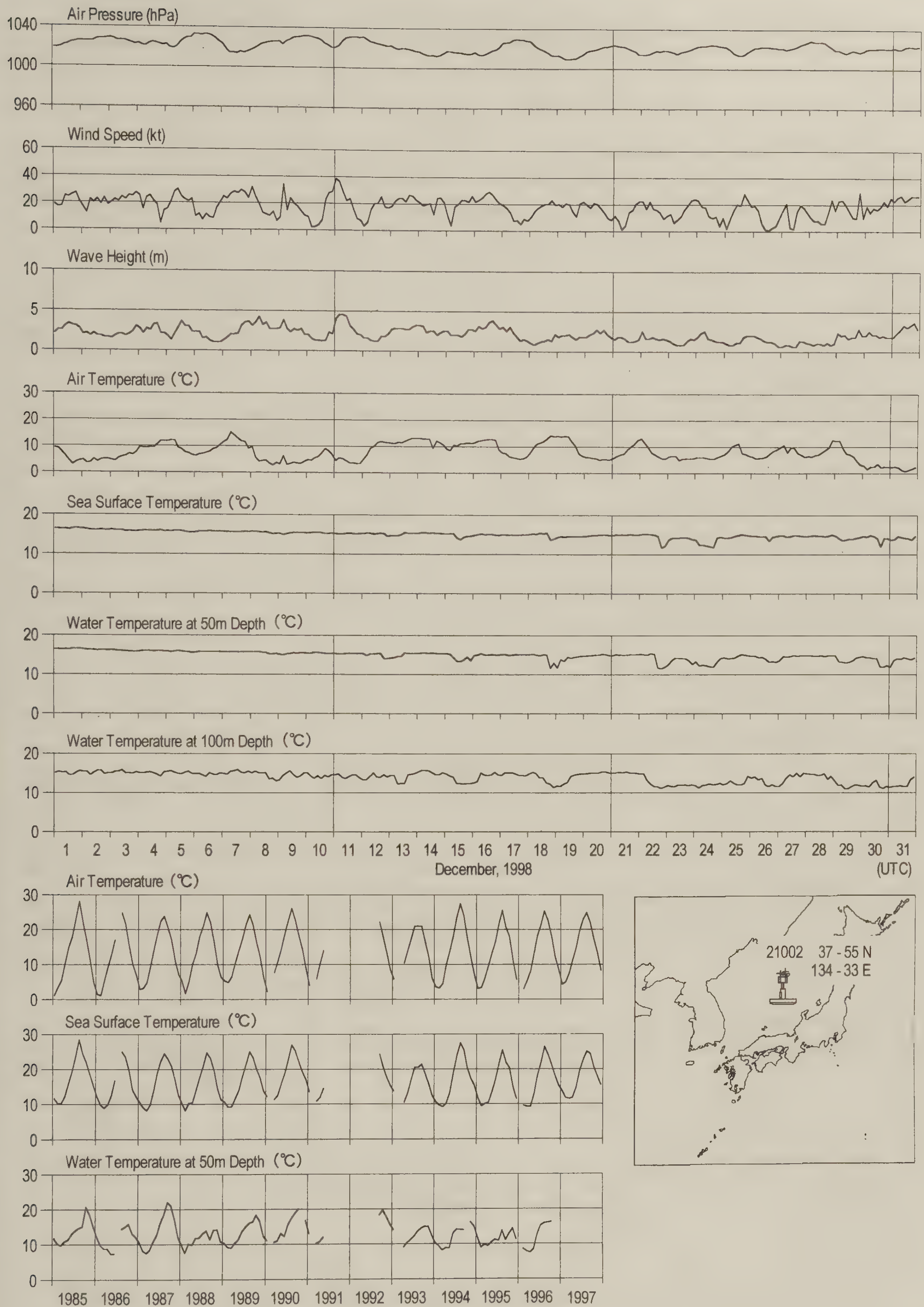
FM: full moon, FQ: first quarter
NM: new moon, LQ: last quarter
T.P.: Mean sea level of Tokyo Bay (Tokyo Peil)





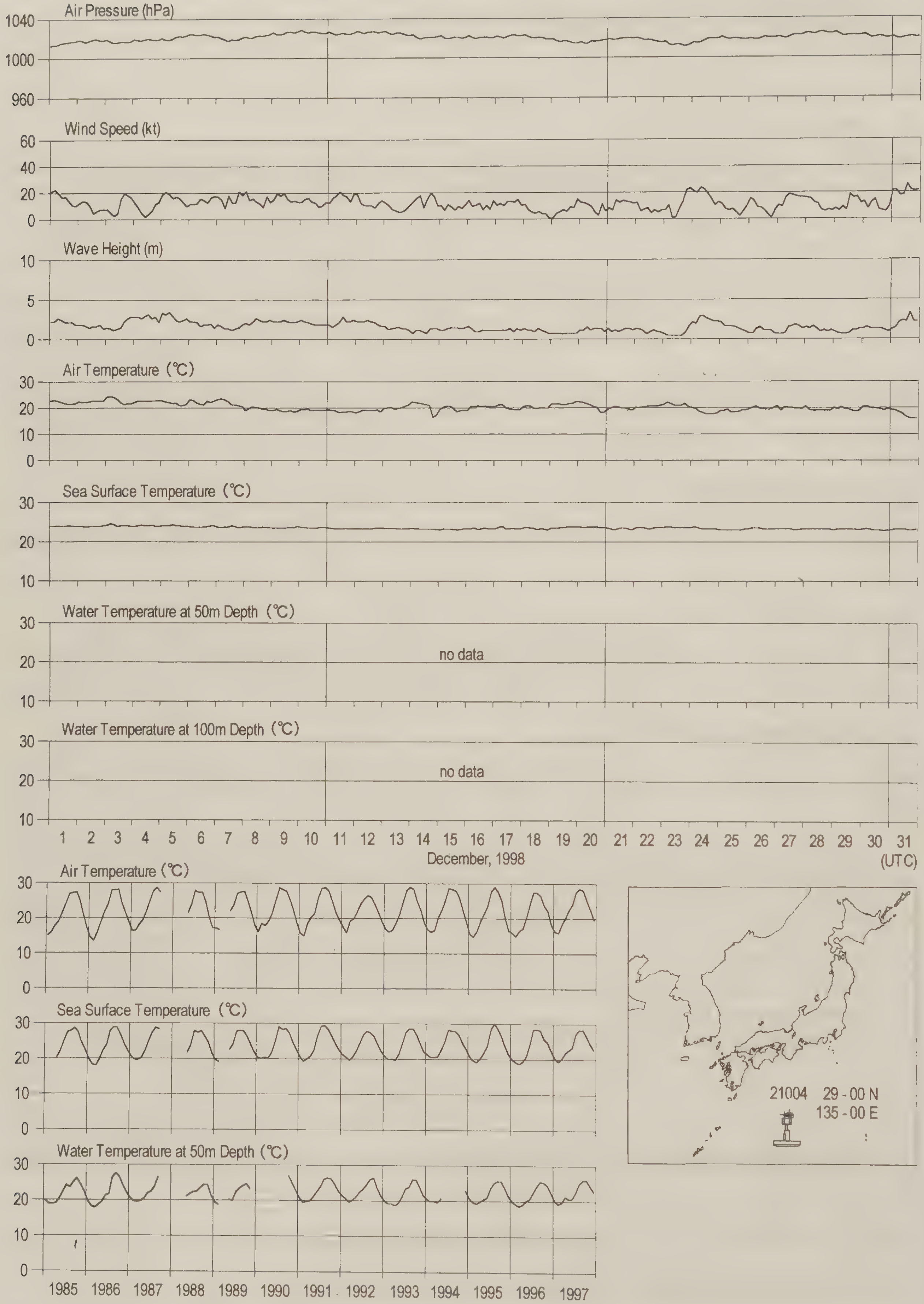
第14図 つづき
Fig.14 continue

Ocean Data Buoy Observations



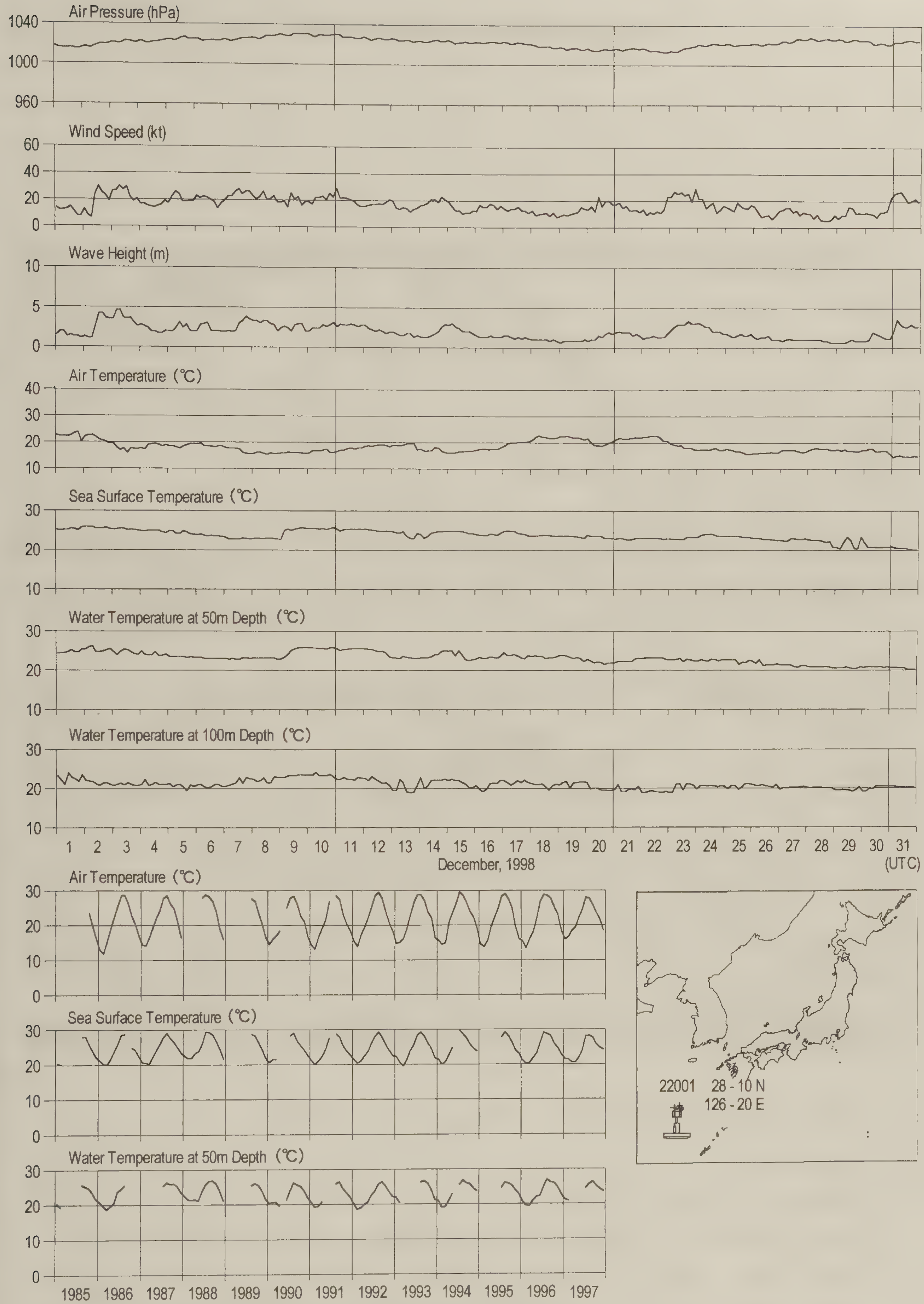
第15図　　海洋気象ブイロボットによる観測要素の時系列図（日本海：21002）
上段は３時間毎の観測値を、下段は月平均値を示す。

Fig. 15　　Time series of JMA buoy observation in the Japan Sea (WMO ID No. 21002).
The upper panel shows three hourly observation and the lower panel shows the monthly mean data.



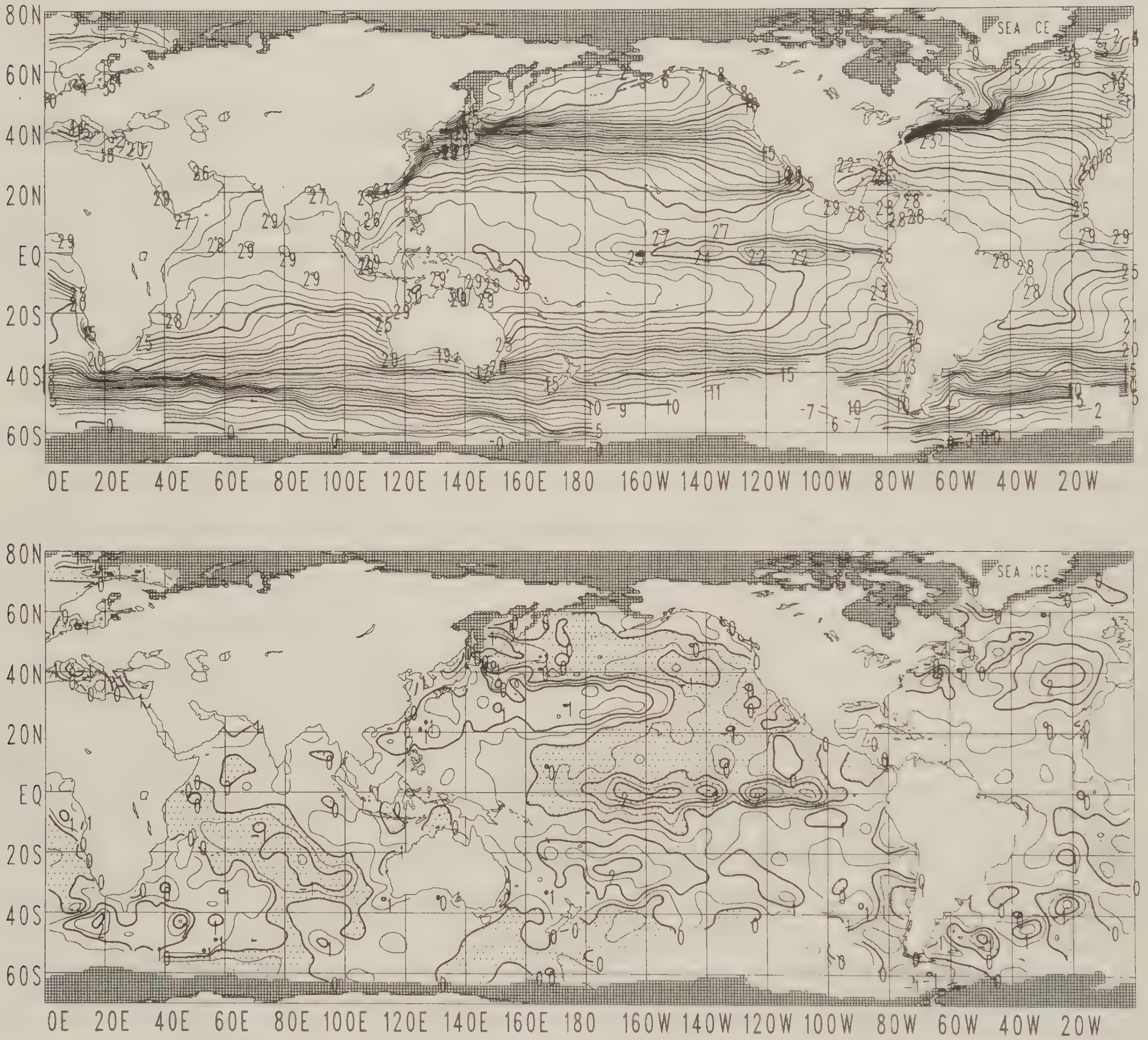
第15図　海洋気象ブイロボットによる観測要素の時系列図（四国沖：21004）
上段は３時間毎の観測値を、下段は月平均値を示す。

Fig. 15　Time series of JMA buoy observation south of Shikoku (WMO ID No. 21004).
The upper panel shows three hourly observation and the lower panel shows the monthly mean data.



第15図　海洋気象ブイロボットによる観測要素の時系列図（東シナ海：22001）
上段は３時間毎の観測値を、下段は月平均値を示す。

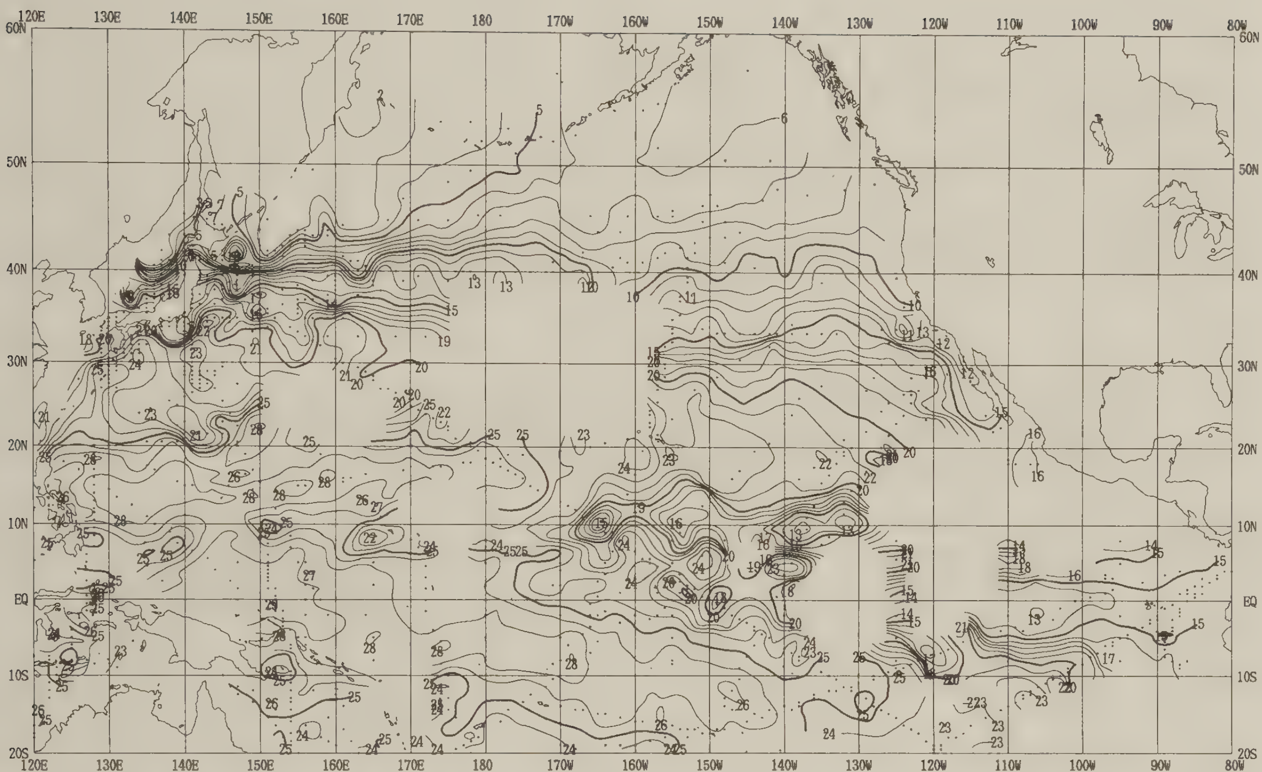
Fig. 15　Time series of JMA buoy observation in the East China Sea (WMO ID No. 22001). The upper panel shows three hourly observation and the lower panel shows the monthly mean data.



第16図　全球月平均海面水温図（上）及び偏差図（下）（1998年12月）

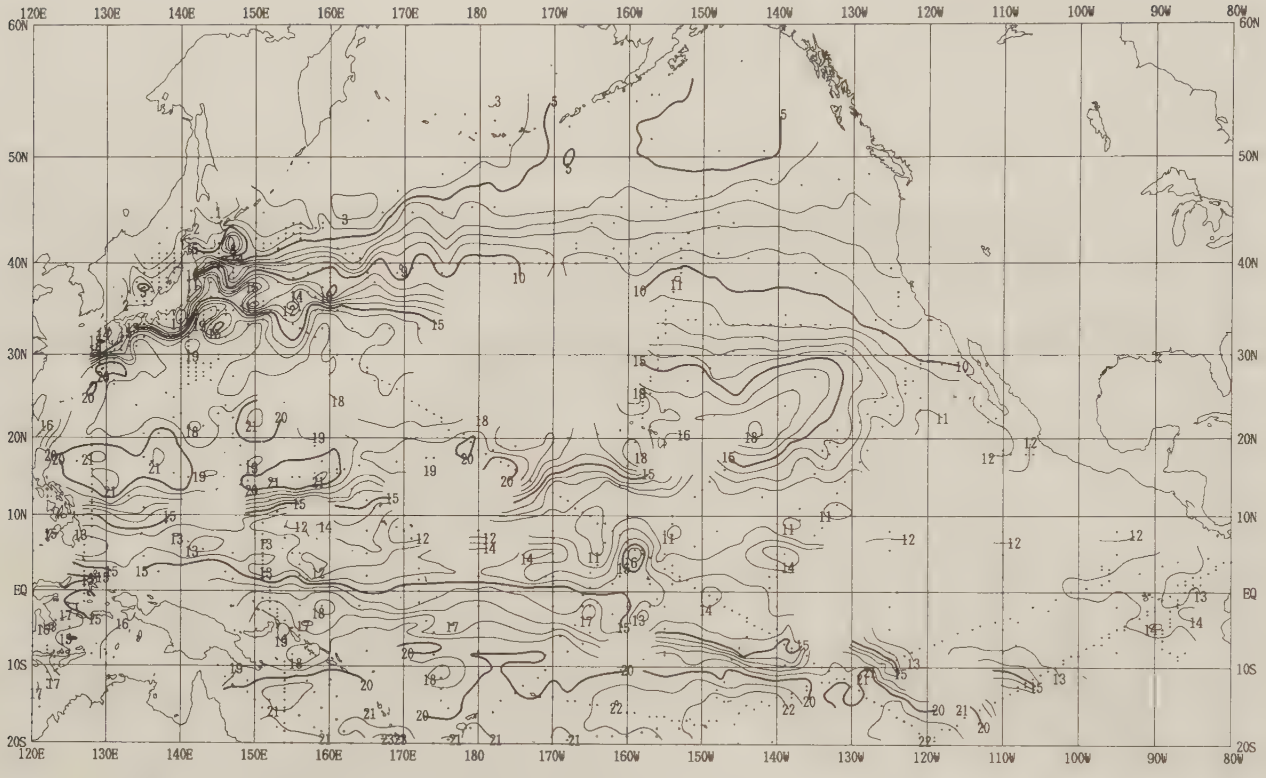
Fig.16 Monthly mean sea surface temperature over the global ocean (top) and anomalies (bottom) for DEC 1998. Anomalies are computed from the JMA climatology (1961-1990). Contour interval is 1°C (top) and additional anomaly contours of ±0.5°C are shown by thin lines. Negative anomalies are spotted. Maximum coverage of sea ice is shaded. Data sources for sea ice are U.S. National Ice Center (polar regions) and JMA (the Sea of Okhotsk).

100m Temperatures in the Pacific Ocean



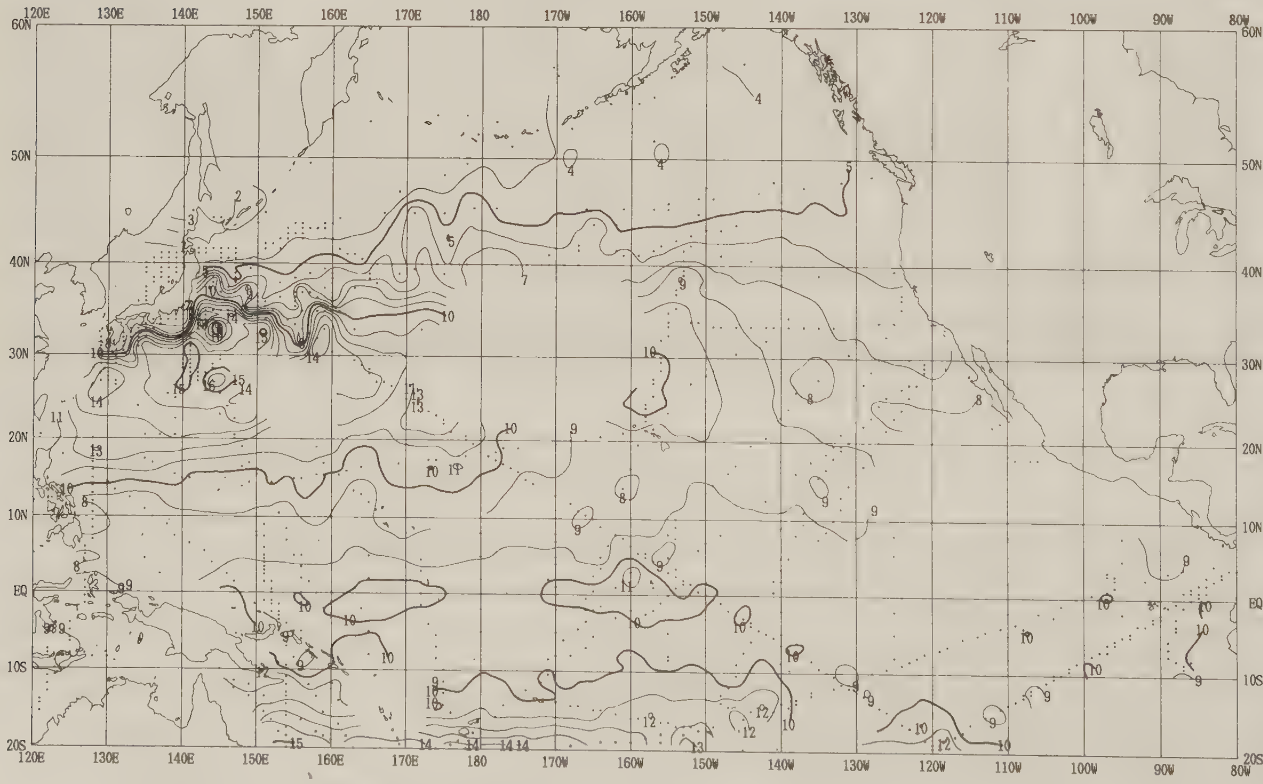
第17図　太平洋表層水温図(深さ100m)（1998年12月）

Fig.17 Subsurface (100m) temperatures in the Pacific Ocean for DEC 1998. Contour interval is 1°C. Observation points are denoted by dots.



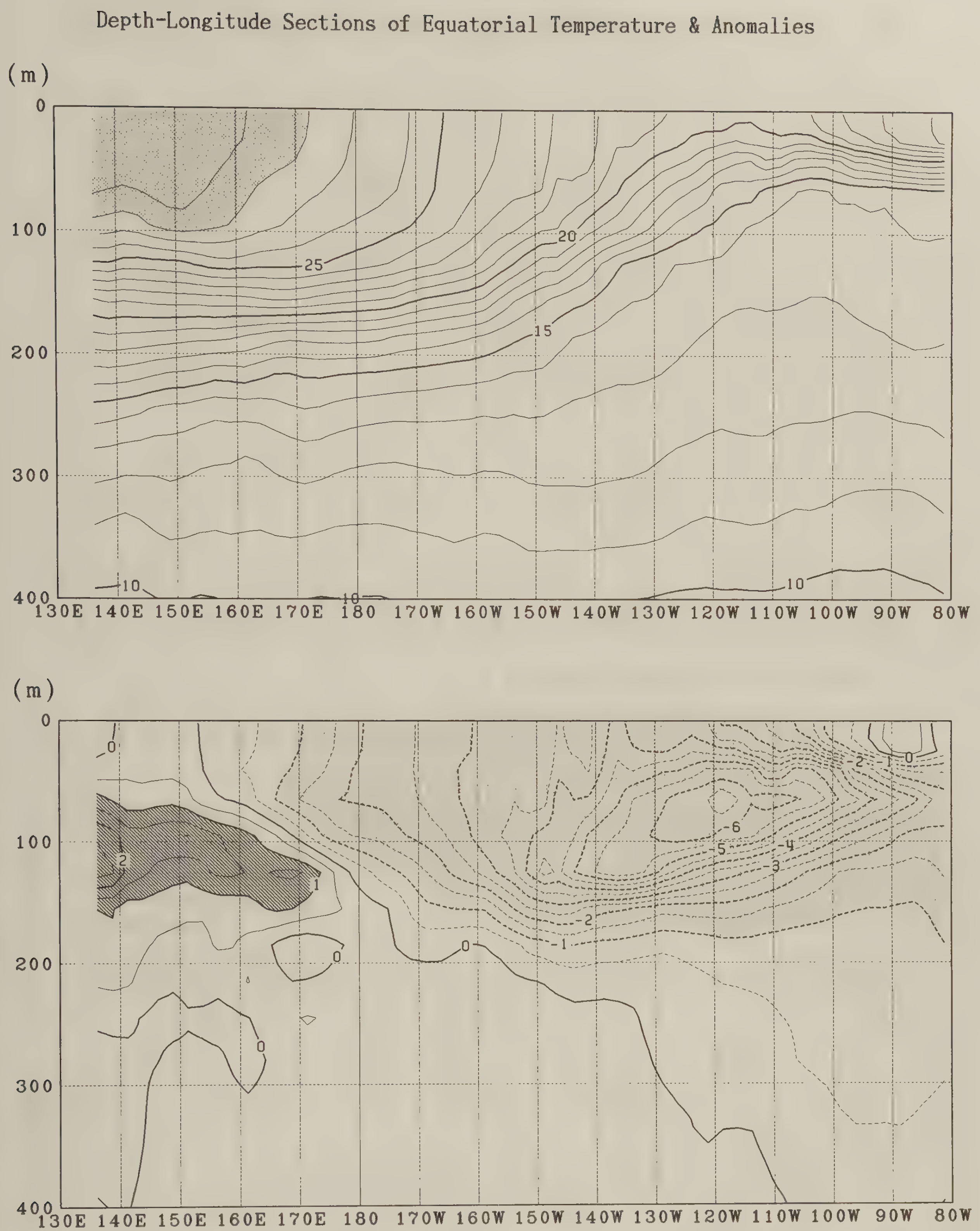
第18図　太平洋表層水温図(深さ200m)（1998年12月）

Fig.18 Subsurface (200m) temperatures in the Pacific Ocean for DEC 1998.
Contour interval is 1°C. Observation points are denoted by dots.



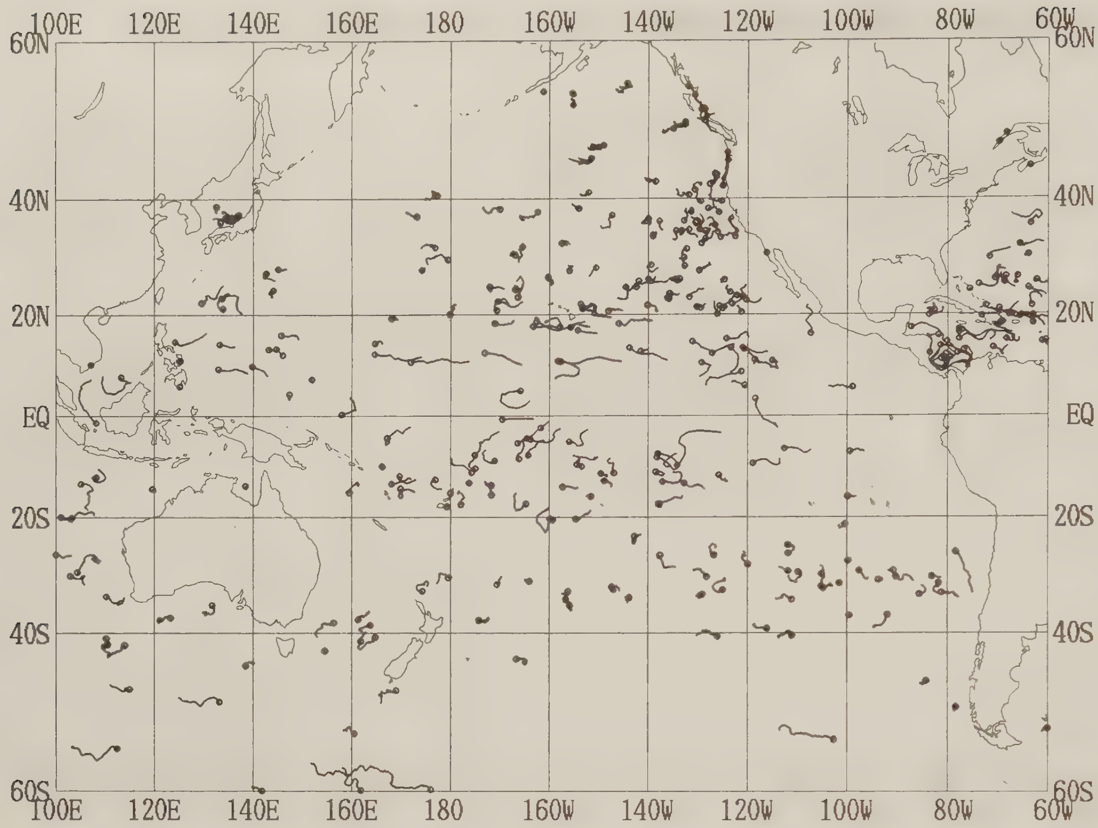
第19図　太平洋表層水温図(深さ400m)（1998年12月）

Fig.19 Subsurface (400m) temperatures in the Pacific Ocean for DEC 1998.
Contour interval is 1°C. Observation points are denoted by dots.



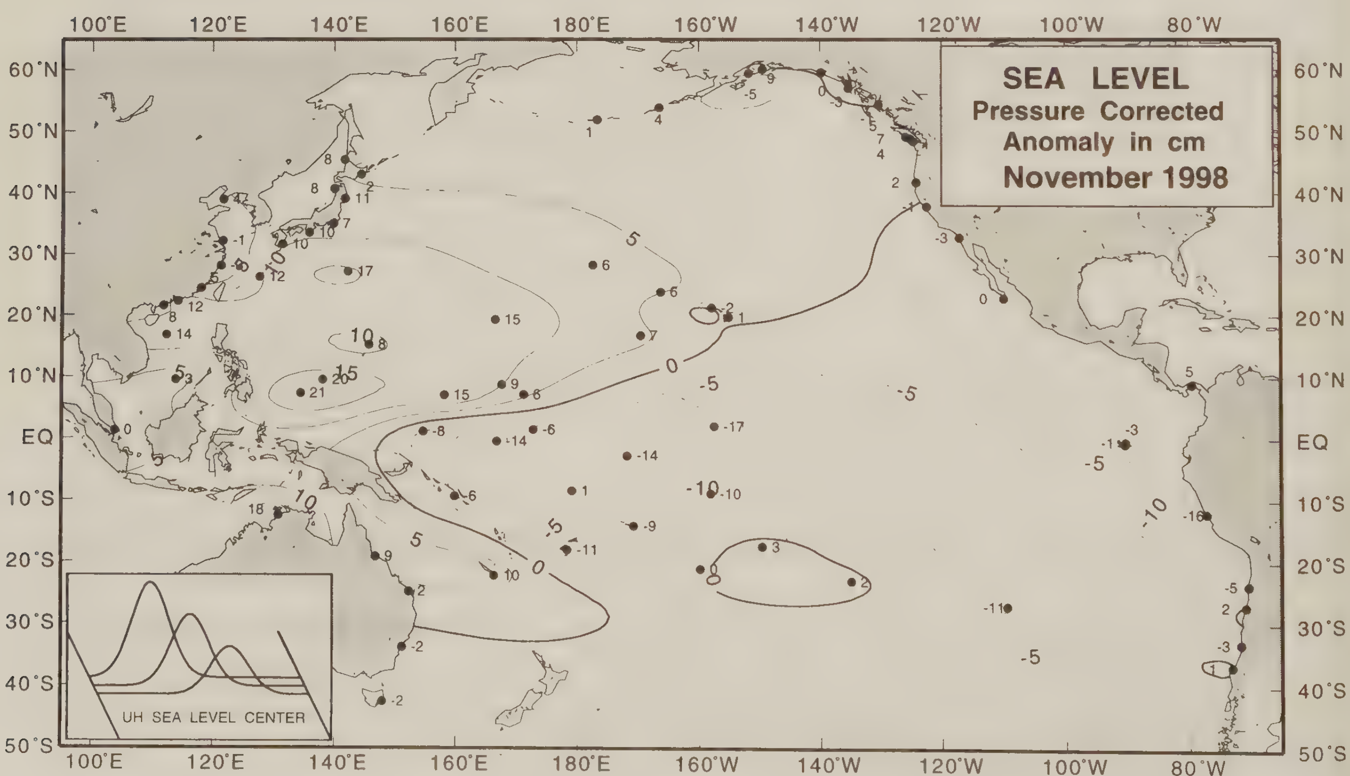
第20図　太平洋赤道に沿う表層水温（上）及び偏差（下）の深度－経度断面図（1998年12月）

Fig.20 Depth-longitude sections of temperature (top) and anomalies (bottom) along the equator in the Pacific Ocean for DEC 1998. Data are derived from the Ocean Data Assimilation System of JMA. Contour interval is 1°C (top) and 0.5°C (bottom). Values greater than 28°C in the top panel are shaded. In the bottom panel, values greater than 1°C are shaded and values less than -1°C are spotted. Anomalies are computed from 1987-1997 base period means.



第21図　太平洋ブイ流跡図(1998年12月)

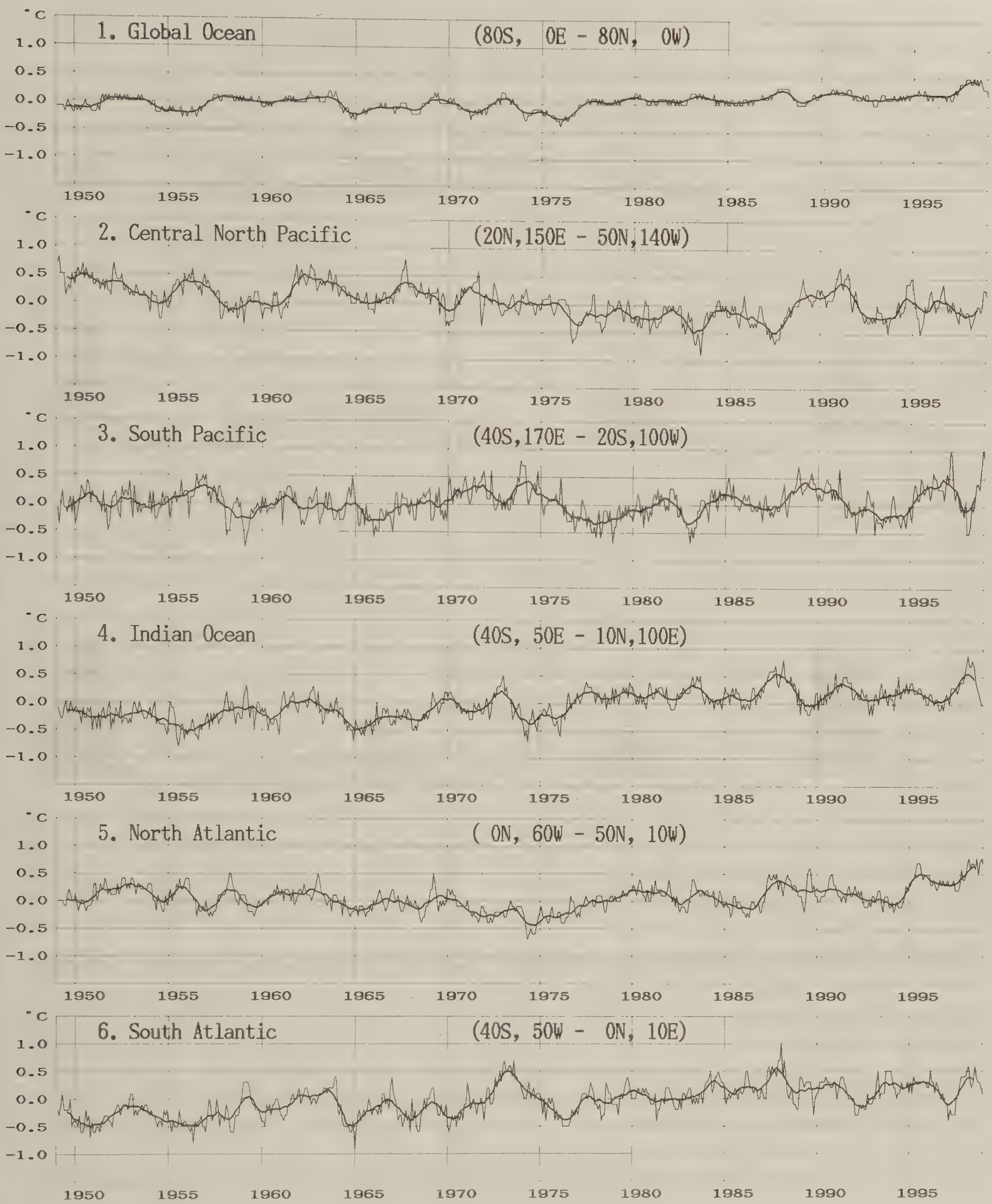
Fig.21 Movements of drifting buoys in the Pacific Ocean during DEC 1998. Each track is for one buoy. Small circles represent last positions for the month.



第22図　太平洋海面水位偏差図 (1998年11月)

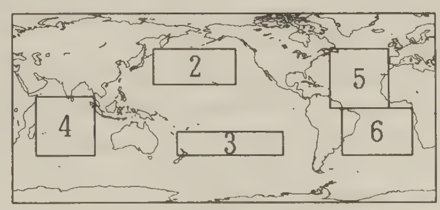
Fig.22 Monthly sea level anomalies for NOV 1998 obtained from mean sea level (1975-1995) adjusted for atmospheric pressure. This figure is prepared by the SOC of ISLP-PAC, Dept. of Oceanography, Univ. of Hawaii.

Long-term Variation of Monthly Mean SST Anomalies

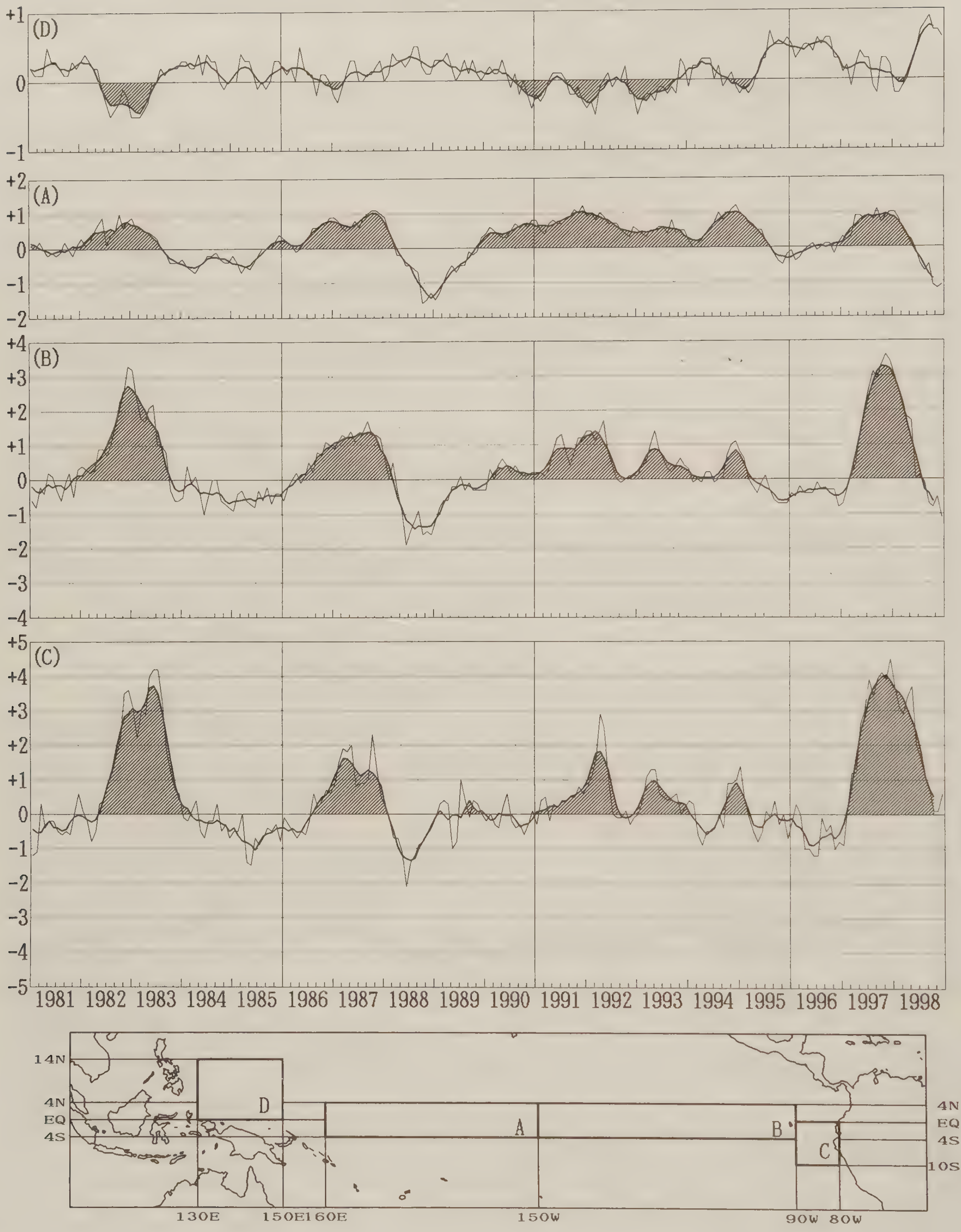


第23図 海域平均海面水温偏差の長期変動

Fig.23 Long-term variations of monthly mean sea surface temperature anomalies (°C) for the areas shown in the right panel. Anomalies are computed from the JMA climatology (1961-90). Thin lines show the monthly mean and thick lines their 13-month running means.



Time Series of Equatorial Pacific SST Anomalies



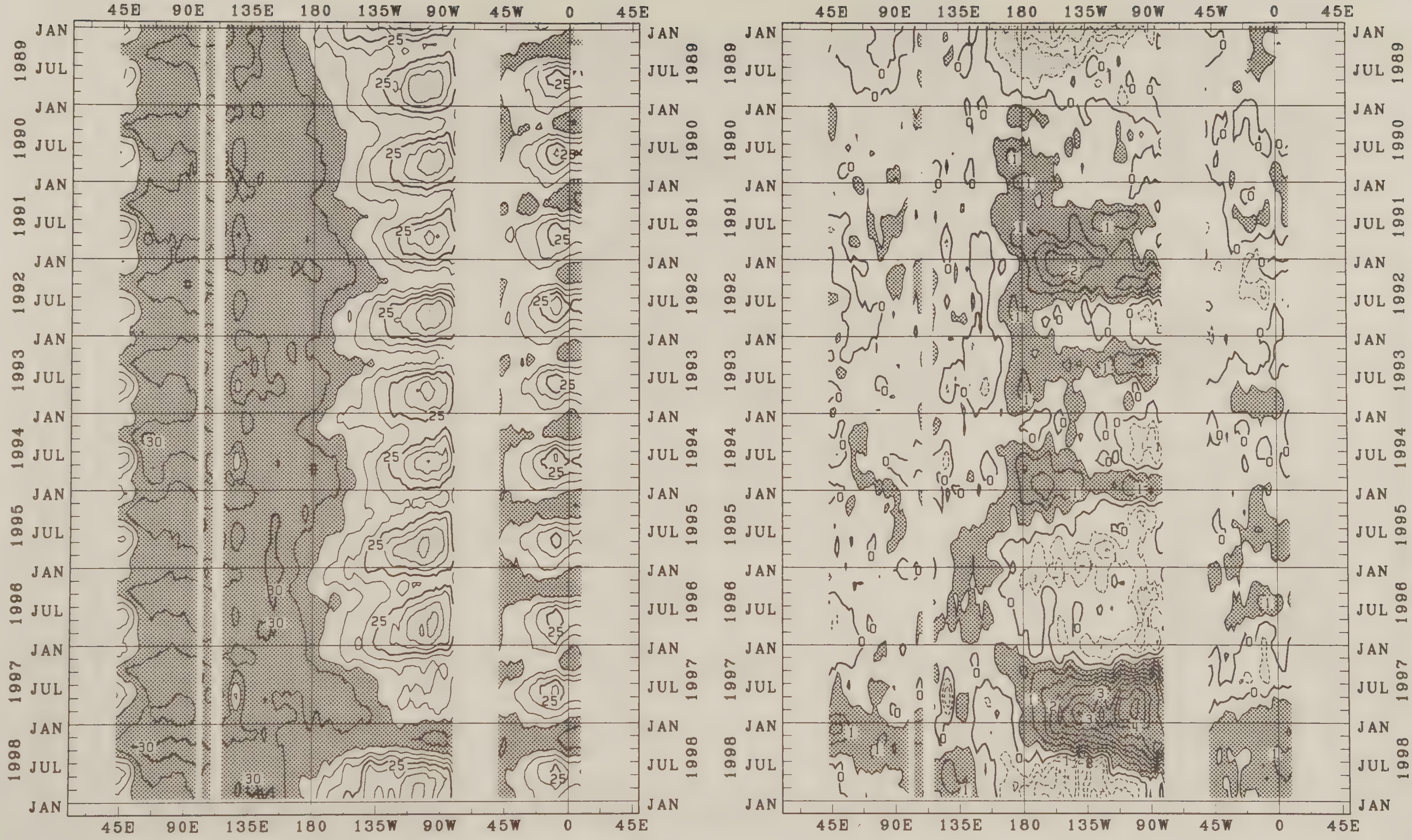
第24図　太平洋赤道域の海面水温偏差時系列図

Fig.24 Time series of monthly mean SST anomalies (°C) in the equatorial Pacific Ocean for the areas indicated at the bottom panel. Thin lines show the monthly means and thick lines their 5-month running means. Positive anomalies (A, B, C) and negative anomalies (D) are shaded. Anomalies are computed from the JMA climatology (1961-1990).

MONTH	SEA SURFACE TEMPERATURE AND ANOMALY (°C) REGION D 14N-EQ 130E-150E		REGION A 4N-4S 160E-150W		REGION B 4N-4S 150W-90W		REGION C EQ-10S 90W-80W		SOI	SEA LEVEL PRESSURE ANOMALY (hPa) TAHITI 17-33S 149-37W	DARWIN 12-24S 130-52E
JAN 96	29.0	0.5	27.9	-0.1	25.0	-0.4	24.1	-0.2	0.8	1.0	-0.7
FEB 96	28.6	0.3	27.6	-0.4	25.7	-0.5	26.0	0.3	0.1	-0.2	-0.5
MAR 96	28.8	0.4	27.8	-0.3	26.7	-0.2	25.9	0.0	0.7	1.0	-0.3
APR 96	29.3	0.5	28.1	-0.1	26.7	-0.4	24.1	-1.0	0.8	0.5	-0.5
MAY 96	29.6	0.5	28.5	0.0	26.2	-0.4	22.9	-1.0	0.3	1.2	1.2
JUN 96	29.7	0.4	28.6	0.1	25.7	-0.4	21.5	-1.2	1.4	1.6	-0.2
JUL 96	29.8	0.6	28.4	-0.1	25.1	-0.1	20.4	-1.2	0.7	0.6	-0.6
AUG 96	29.6	0.5	28.4	0.0	24.3	-0.3	20.5	-0.1	0.4	0.4	-0.3
SEP 96	29.8	0.6	28.4	0.1	24.3	-0.3	19.8	-0.5	0.5	-0.7	-1.7
OCT 96	29.9	0.6	28.5	0.1	24.3	-0.3	20.4	-0.3	0.4	-0.1	-0.8
NOV 96	29.5	0.3	28.2	-0.2	24.3	-0.3	20.5	-1.0	-0.0	-0.5	-0.5
DEC 96	29.2	0.3	28.3	0.1	24.1	-0.8	21.8	-0.8	0.8	-0.3	-1.9
JAN 97	28.6	0.1	28.3	0.3	24.7	-0.7	23.4	-0.9	0.3	1.7	0.9
FEB 97	28.5	0.2	28.2	0.2	25.9	-0.3	25.9	0.2	1.2	1.0	-1.9
MAR 97	28.3	-0.1	28.4	0.3	27.0	0.1	27.1	1.2	-0.6	-0.5	0.9
APR 97	29.0	0.2	29.1	0.9	27.5	0.4	26.3	1.2	-1.1	0.4	2.3
MAY 97	29.5	0.4	29.4	0.9	27.9	1.3	26.5	2.6	-2.5	-2.1	0.9
JUN 97	29.6	0.3	29.3	0.8	28.1	2.0	25.7	3.0	-2.3	-0.8	2.1
JUL 97	29.5	0.3	29.4	0.9	27.8	2.6	25.5	3.9	-0.8	-0.1	1.2
AUG 97	29.0	-0.1	29.2	0.8	27.7	3.1	24.0	3.4	-2.0	-0.9	2.2
SEP 97	29.0	-0.2	29.4	1.1	27.5	2.9	24.2	3.9	-1.4	0.1	2.7
OCT 97	29.6	0.3	29.1	0.7	27.9	3.3	24.8	4.1	-1.6	-0.2	2.7
NOV 97	29.5	0.3	29.3	0.9	28.2	3.6	25.4	3.9	-1.2	0.4	2.7
DEC 97	29.1	0.2	29.2	1.0	28.3	3.4	27.1	4.5	-0.9	-0.5	1.1
JAN 98	28.3	-0.2	29.0	1.0	28.4	3.0	28.0	3.7	-2.3	-3.6	1.4
FEB 98	28.1	-0.2	28.8	0.8	28.8	2.6	28.8	3.1	-1.8	-0.9	3.5
MAR 98	28.3	-0.1	28.6	0.5	29.0	2.1	28.8	2.9	-2.5	-2.8	2.3
APR 98	28.8	0.0	28.5	0.3	28.9	1.8	28.5	3.4	-2.3	-1.5	1.4
MAY 98	29.3	0.2	28.7	0.2	28.3	1.7	27.6	3.7	0.0	0.4	0.5
JUN 98	29.7	0.4	28.4	-0.1	26.1	0.0	24.7	2.0	1.1	0.9	-0.5
JUL 98	29.9	0.7	28.0	-0.5	25.3	0.1	23.2	1.6	1.5	1.8	-0.6
AUG 98	29.9	0.8	27.7	-0.7	24.5	-0.1	21.7	1.1	1.0	1.4	-0.2
SEP 98	30.1	0.9	27.8	-0.5	23.9	-0.7	21.0	0.7	1.0	1.4	-0.4
OCT 98	30.0	0.7	27.3	-1.1	23.8	-0.8	20.8	0.1	1.2	0.8	-1.1
NOV 98	29.9	0.7	27.2	-1.2	24.1	-0.5	21.6	0.1	1.0	0.4	-1.5
DEC 98	29.5	0.6	27.1	-1.1	23.8	-1.1	23.2	0.6	1.5	1.1	-1.5

第1表　エルニーニョ監視指数

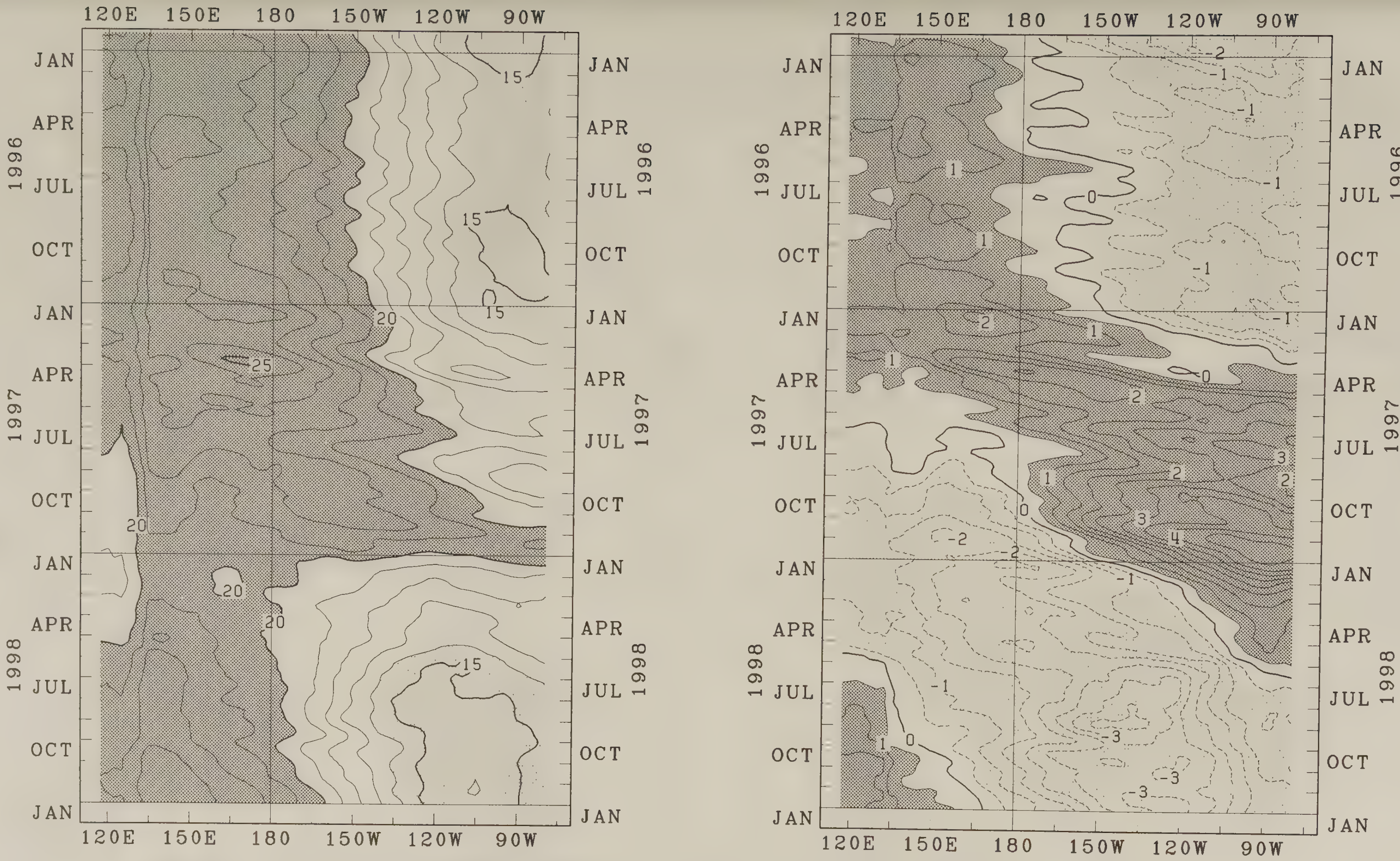
Table 1 El Nino Monitoring indices



第 25 図　赤道に沿った海面水温（左）および偏差（右）の時間-経度断面図

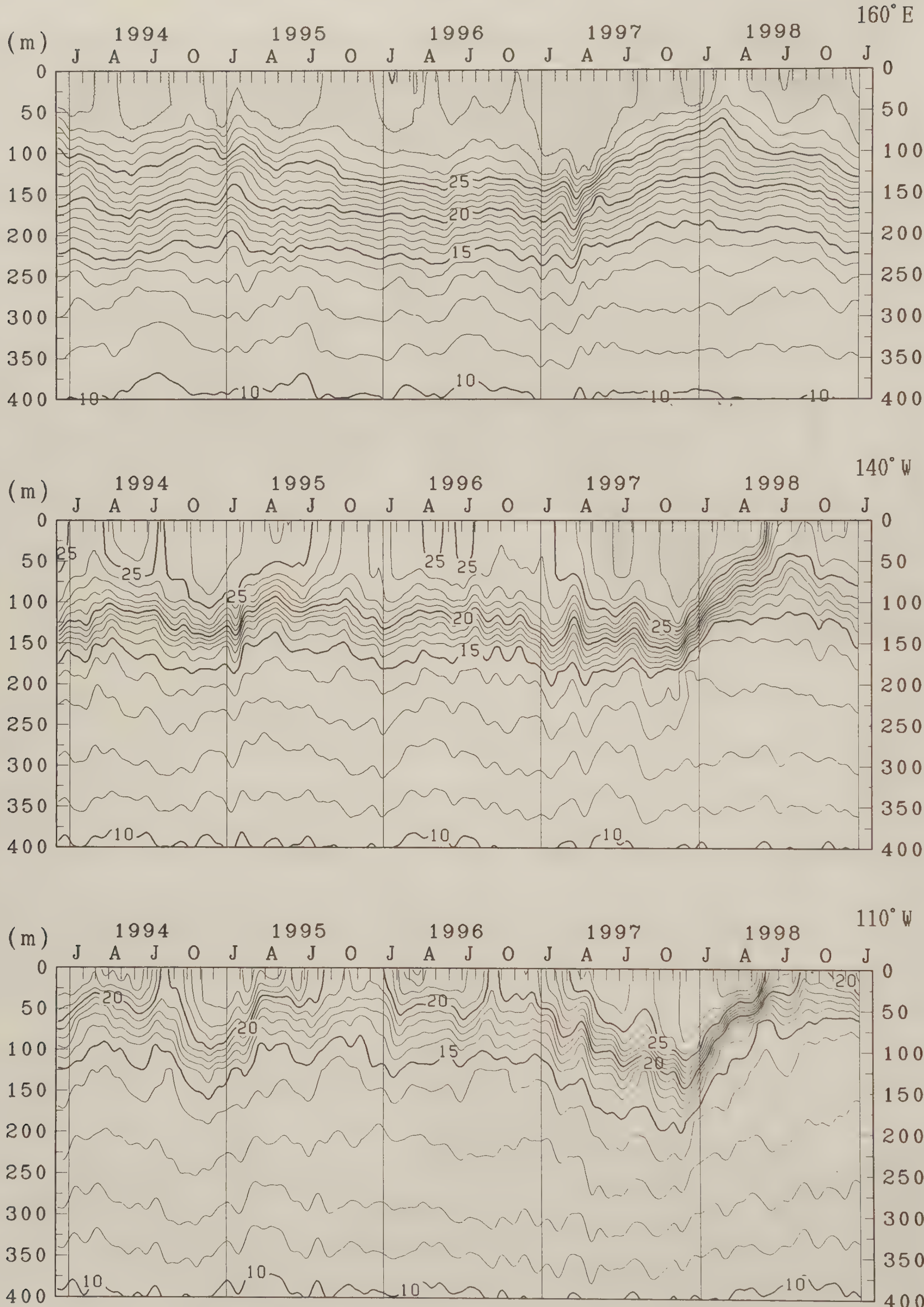
Fig.25　Time-longitude sections of SSTs (left) and anomalies (right) along the equator (2 ˚N-2 ˚S) in the global ocean. Contour interval is 1 ˚C (left) and 0.5 ˚C (right). Values greater than 28 ˚C are shaded and values less than 23 ˚C are spotted in the left panel. Dashed contours indicate negative anomalies in the right panel. Anomalies are computed from 1961-1990 base period means.

Time-Longitude Sections of Ocean Heat Content & Anomalies (Eq.)



第26図　太平洋の赤道に沿う海洋表層の貯熱量（左）及び偏差（右）の時間－経度断面図

Fig.26 Time-longitude sections of ocean heat content in the upper 260m along the equator (left) and anomalies (right) in the Pacific Ocean. Data are derived from the Ocean Data Assimilation System of JMA. Contour interval is 1°C (left) and 0.5°C (right). Values greater than 20°C are shaded and values less than 16°C are spotted in the left panel. Dashed contours indicate negative anomalies in the right panel. Anomalies are computed from 1987-1997 base period means.



第27図　太平洋赤道域の表層水温の時間－深度断面図
（上：西部、中：中部、下：東部）

Fig.27 Time-depth sections of equatorial subsurface temperature for the western Pacific (top, 160°E), the central Pacific (middle, 140°W) and the eastern Pacific (bottom, 110°W). Data are derived from the Ocean Data Assimilation System of JMA. Contour interval is 1°C. Values greater than 28°C are shaded.

Sea Ice

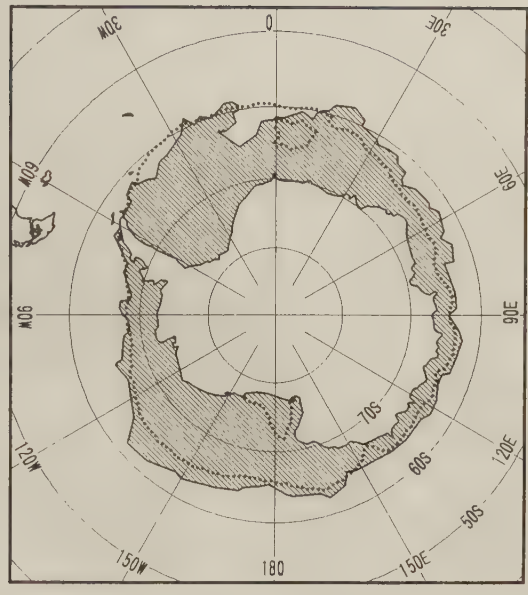


第28-1図 北極域の海氷図（1998年12月18日）

Fig.28-1 Sea ice chart in the Arctic on 18 Dec. 1998.

The shaded area represents the sea ice extent. The dotted line denotes the mean ice edge averaged for the period from 1972 through 1990.

The data source is the National Ice Center (USA).

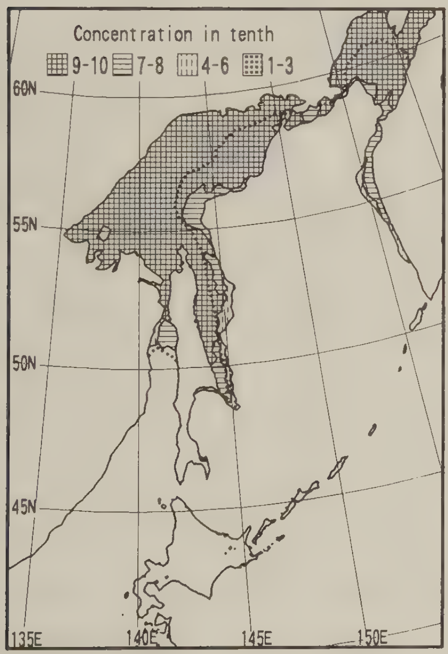


第28-2図 南極域の海氷図（1998年12月18日）

Fig.28-2 Sea ice chart in the Antarctic on 18 Dec. 1998.

The shaded area represents the sea ice extent. The dotted line denotes the mean ice edge averaged for the period from 1973 through 1990.

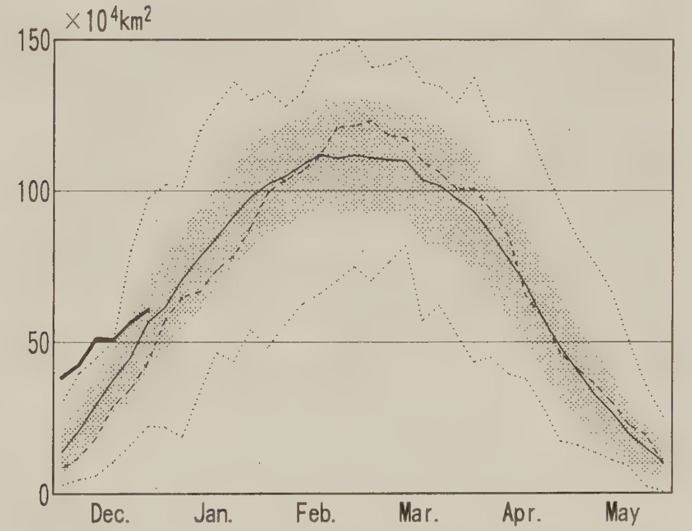
The data source is the National Ice Center (USA).



第28-3図 オホーツク海の海氷図（1998年12月15日）

Fig.28-3 Sea ice chart in the Sea of Okhotsk on 15 Dec. 1998.

The dotted line denotes the mean ice edge averaged for the period from 1971 through 1995.



第28-4図 オホーツク海の海氷域面積（1998-1999）

Fig.28-4 Time-series of 5-day sea ice extent in the Sea of Okhotsk (1998-1999).

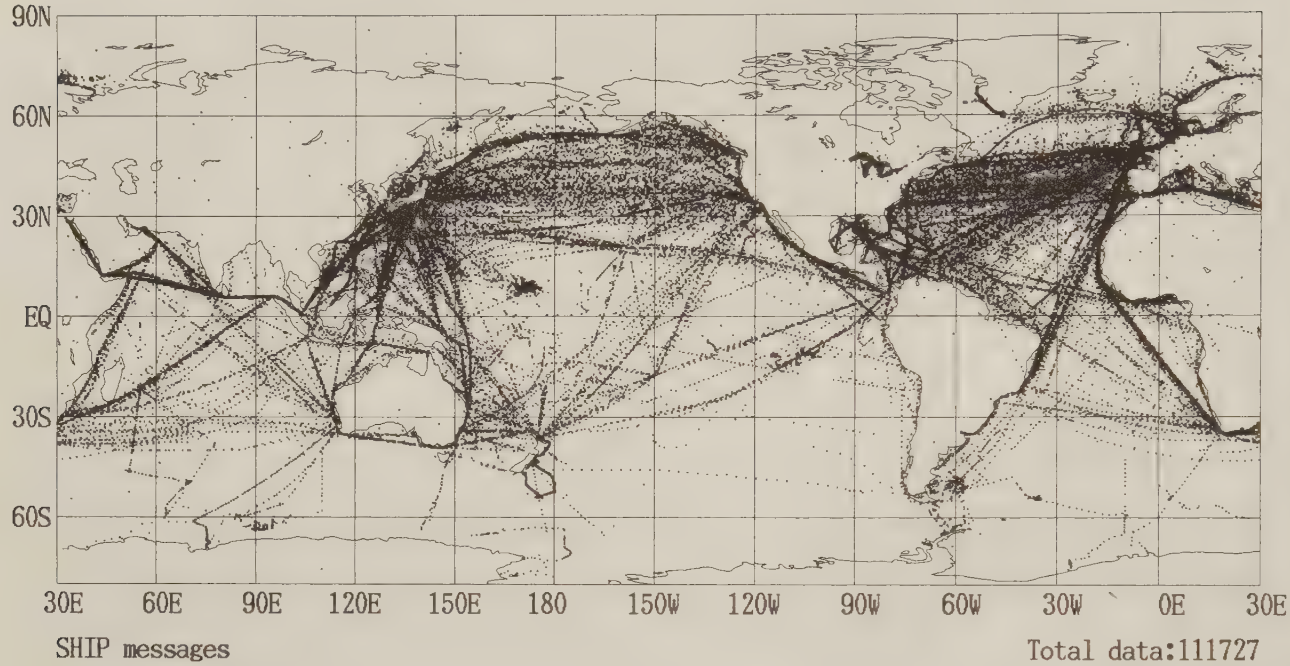
: current season (1998/99)

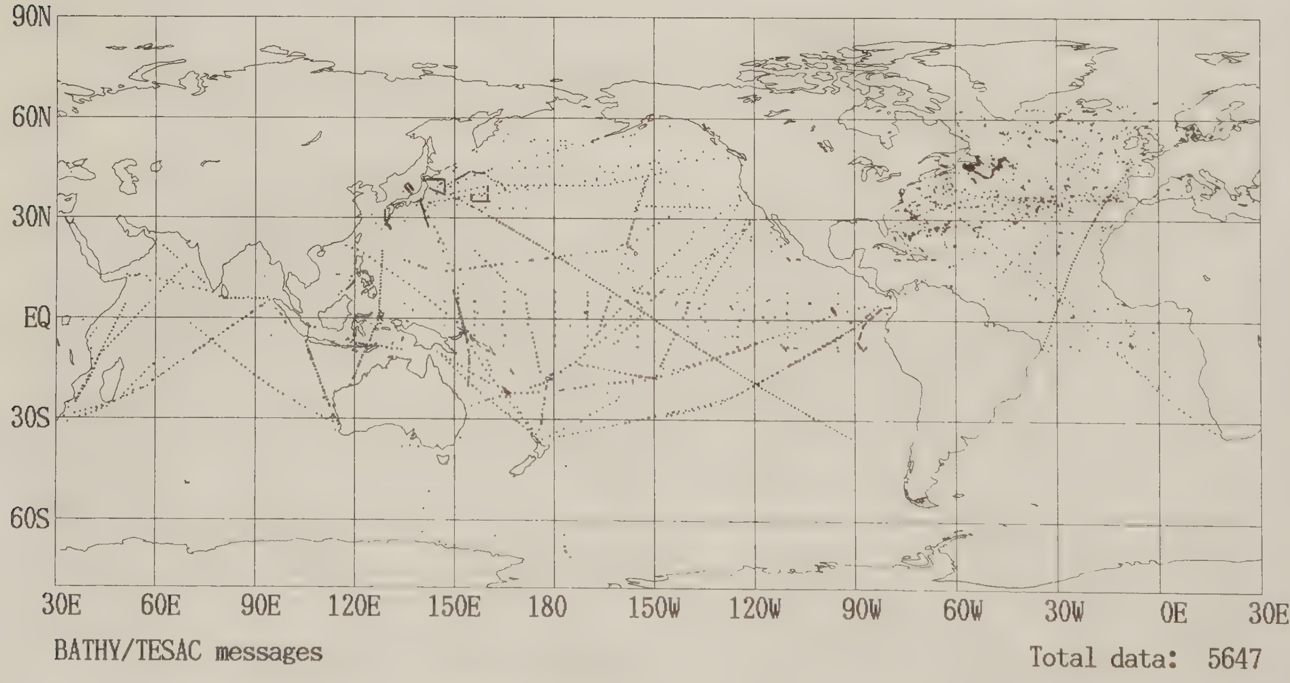
: mean extent (1971-1995)

: maximum or minimum extent (1971-1998)

: last season (1997/98)

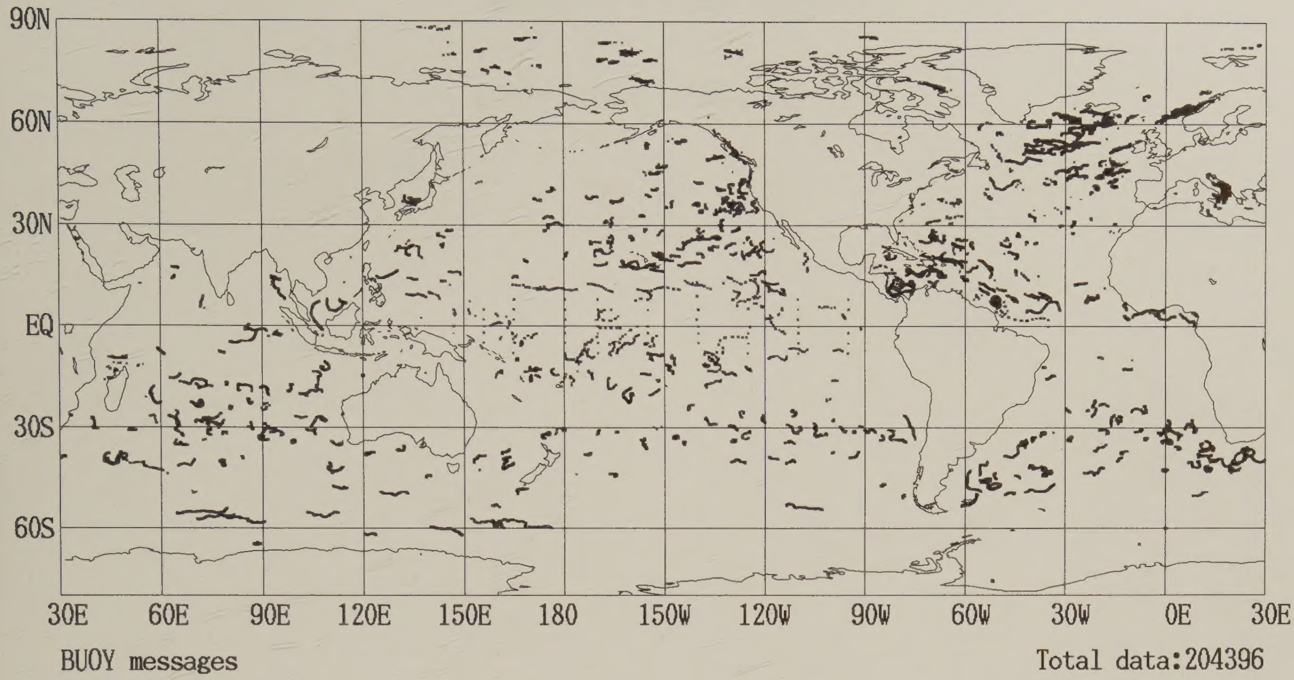
: mean $\pm 1\sigma$ (1971-1995)

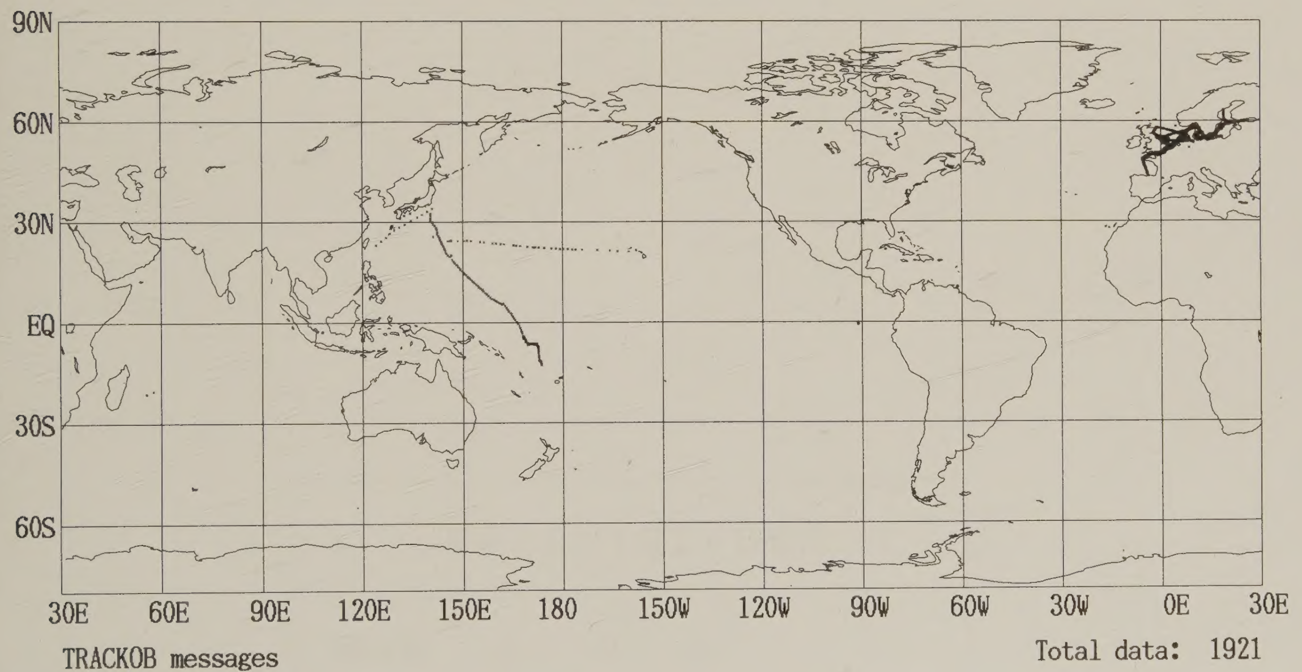




第29-1図　測点分布図(1998年12月)

Fig.29-1 Geographical distribution of SHIP messages (SST data, top) and BATHY/TESAC messages (subsurface temperature data, bottom) for DEC 1998.





第29-2図　測点分布図(1998年12月)

Fig.29-2 Geographical distribution of BUOY messages (buoy drift and SST data, top) and TRACKOB messages (ship drift and SST data, bottom) for DEC 1998.

気 象 庁 海 洋 月 報

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